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CONTROL OF RAGWORT WITH "ATLACIDE" AS COMPARED WITH SODIUM CHLORATE.

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THE advocacy of sodium chlorate as a weed-killer, particularly in the control by spraying of ragwort (*Senecio jacobæa*), has necessitated much emphasis being placed on its dangerous properties when in the hands of a careless individual. While there is not much fear of accident provided reasonable precautions are taken, such as the thorough rinsing of clothes saturated with the material, the occurrence of accidents, some with fatal consequences, has intensified the search for a substitute equally effective in regard to weed-control and free from the attendant risks. Aston(1) describes experiments with thio-cyanates in controlling ragwort, and mentions that these materials are not combustible or explosive when in contact with organic materials. In discussing substitutes for sodium chlorate Deem(2) mentions "Atlacide" as having been thoroughly tested to show an efficiency slightly less than that of sodium chlorate, but to have the advantage of little or no risk through fire or explosion.

Representations made by the agents of "Atlacide" to have the product included in the Government subsidy granted to importers of sodium chlorate necessitated further trials being carried out to compare both these substances when used on ragwort. One series of trials was conducted in the King-country, South Taranaki, and in Southland during 1935, while a second series of experiments, on a larger scale, was conducted in the Auckland Province during 1936.

PROPERTIES OF "ATLACIDE."

"Atlacide" is a proprietary material containing sodium chlorate, calcium chloride, and other chemicals.

A report from the U.S. Bureau of Explosives states that "Atlacide" is inherently safer than sodium chlorate on account of the inert matter tending to nullify the explosive properties of sodium chlorate and its hygroscopic tendencies. A significant characteristic of "Atlacide" is its great apparent resistance to ignition by friction or impact. Actual trials carried out by independent chemists have indicated this resistance to obtain under field conditions.

The material is in the form of a fine powder, and in this condition it is specially suited for direct application as a dust.

Experiments with "Atlacide," 1935 Season.

Experiments on ragwort were laid down in the autumn of 1935 on five farms. The treatments included applications of 1 per cent., 3 per cent., and 5 per cent. solution of "Atlacide" and sodium chlorate respectively, and also these materials applied in the dry state mixed with carbonate of lime in two different proportions—viz., 2 parts specific to 98 parts lime and 5 parts specific to 95 parts lime. The actual quantities of solution or dust applied were kept constant as far as possible.

In each experiment plots of $\frac{1}{80}$ acre were taken on which ragwort was growing fairly thickly, and the number of plants on each plot was ascertained before treatment. Counts were taken about three weeks after treatment and again about ten weeks after treatment, although the second observation was generally difficult in view of seedling plants which had made their appearance after the dying-down of the older plants. Inconsistencies between the numbers of these seedlings on plots treated with various strengths of the same specific suggest that small differences in the number of seedlings may be entirely fortuitous, particularly as the materials were applied to large plants, and their effect on seedling-growth has not therefore been considered. The effect on the weeds which were actually sprayed is shown in Table I.

Table I.—Effect on Ragwort of "Atlacide" (Old Formula) and Sodium Chlorate respectively in Experiments, 1935 Season.

Specific.	Strength of Solution or Mix.	Percentage Kill in various Trials (Name of Co-operating Farmer given in each case).				
		E. V. Allison, Te Kuiti.	F. Schnelle, Te Kuiti.	A. Bettridge, Tawhiti.	R. Russell, Waianiwa.	A. Scott, Tisbury.
Sodium chl. ..	1 per cent. ..	83	99·5	100	100	No spray treatments.
Atlacide ..	1 per cent. ..	65	99	100	100	
Sodium chl. ..	3 per cent. ..	99	100	100	100	
Atlacide ..	3 per cent. ..	88	100	100	99	
Sodium chl. ..	5 per cent. ..	99	100	100	100	
Atlacide ..	5 per cent. ..	96	100	100	100	
Sodium chl. ..	2 to 98 lime ..	90	100	100	No dust treatments	98·6
Atlacide ..	2 to 98 lime ..	61	99	100		97·5
Sodium chl. ..	5 to 95 lime ..	92	100	100		99·4
Atlacide ..	5 to 95 lime ..	92	100	100		99·1

In four of the trials "Atlacide" and sodium chlorate were about equal in their effect, the trend being slightly in favour of sodium chlorate. The trial shown in the third column had a fair growth of grass and clovers when treated, and possibly many young plants were missed when sprayed or dusted, although this would tend to affect the results from sodium chlorate and "Atlacide" equally.

Experiments with "Atlacide," 1936 Season.

As the manufacturers of "Atlacide" intended adopting a new and improved formula for their material, it was decided to carry out further trials, and nine experiments in which the new material was used were laid down in the autumn of 1936. In most of these trials treatments

were confined to 3-per-cent. and 5-per-cent. solutions, and dry applications consisting of 5 parts of specific to 95 parts carbonate of lime. These mixtures were more in accord with the usual strengths recommended for ragwort-destruction—viz., 3 per cent. to 6 per cent., according to the nature of growth. The same quantities of spray or dust were applied to each plot, and the areas treated ranged from small plots of $\frac{1}{80}$ acre to large blocks of several acres. On the latter, small representative areas were marked off on which the plants were counted before and after treatment. The second counts were taken from three weeks to two months after treatment with the following results :—

Table II.—Effect on Ragwort of "Atlacide" (New Formula) and Sodium Chlorate in Experiments, 1936 Season.

Trial.	Percentage of Sprayed Plants killed.					
	3% Solution.		5% Solution.		Lime, 95%; Specific, 5%.	
	Atlacide.	Sod. Chl.	Atlacide.	Sod. Chl.	Atlacide.	Sod. Chl.
1. Crown lands, Kopaki ..	91·5	96·0	93	96	78	87
2. Crown lands, Kopaki* ..	93·4	99·1	97	99·6	60·3	88·6
3. State Forest, Rotorua ..	92·5	97·7	99·5	95·9	94·2	94·2
4. State Farm, Mamaku ..	100	..	100	100	100	100
5. State Farm, Mamaku ..	89	..	87·8	93·3	..	..
6. A. K. McNaughton, Te Awamutu	..	..	..	..	100	100
7. A. K. McNaughton, Te Awamutu	Trials covered by flood prevented counts being taken. From observations made the merits of "Atlacide" and sodium chlorate were considered equal.					
8. Native lands, Te Awamutu						

* Seedling plants appeared in large numbers after the killing of the older plants in this trial, and a second application of spray or dust was given on 12th May, 1936. Later counts revealed 100 per cent. kill on the sodium-chlorate plots and 99 per cent. kill on those treated with "Atlacide."

Considering the data collectively from experiments with the new formula "Atlacide," the later appears to be about 97 per cent. as effective as sodium chlorate in the 3 per cent. solution, about 99 per cent. as effective in the 5 per cent. solution, and about 93 per cent. as effective when applied in the dry form with lime.

The Place of "Atlacide" in Farming Practice.

No mention of relative costs has been made, as it is understood that "Atlacide," which is now to receive the advantage of the Government subsidy, will be sold at a price competitive with that of sodium chlorate. The comparative safety of "Atlacide" will be a strong point in its favour with some farmers, although, on the other hand, it must be emphasized that reasonable precautions taken when using sodium chlorate almost remove the dangers associated with this material. Government institutions, local bodies, and others employing large numbers of casual labourers in the destruction of weeds, however, may be more apprehensive of the risks, and their responsibility in this connection will be lessened by using "Atlacide." As indicated by the experiments described above, this material has an efficiency almost equal to that of sodium chlorate.

ACKNOWLEDGMENTS.

The field work in connection with these trials was carried out by Instructors K. M. Montgomery, C. Haynes, and A. Stuart, of the Fields Division, in 1935, and by Messrs. Melrose, Newson, Bonner, and McMillan, of the Live-stock Division, and also Mr. K. M. Montgomery, of the Fields Division, in 1936. The assistance of those farmers who co-operated in the trials is cordially acknowledged. Supplies of "Atlacide" were made available by Messrs. B. K. Morton Proprietary, Ltd.

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(2) DEEM, J. W.: *N.Z. Journal of Agriculture*, August, 1931.

APPLICATION OF ORCHARD-SPRAYS.

III. SPRAY NOZZLES.

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DURING the development of commercial spraying various types of nozzles have been evolved with the object of dispersing a small amount of spray liquid over a wide area. Dispersion was effected in the earliest types of nozzles by forcing a jet of liquid against an obstruction such as wire gauze or a metal flange. The most successful nozzle of this type was the "Bordeaux" (Fig. 1), first patented in America in 1878. This nozzle has persisted practically

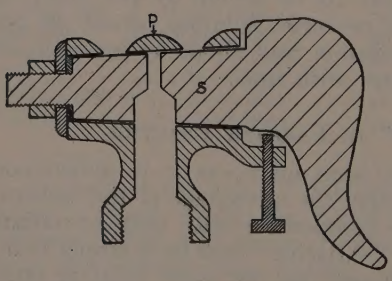

FIG. 1. BORDEAUX NOZZLE.
Stop-cock, S; projecting flange, P.

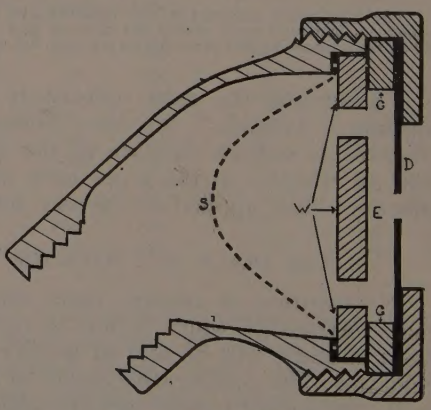

FIG. 2. CYCLONE NOZZLE.
Strainer, S; whorl-plate, W; whorl-chamber, E; rubber gasket, G; disk, D.

unchanged to the present day, but, owing to the coarse spray produced and the difficulty of maintaining correct adjustment, is rarely used in commercial orchards. The principle of imparting a whirling motion to the spray liquid before it left the nozzle was

discovered by W. S. Barnard in 1880 (Riley, 1885). Nozzles built on this principle were termed "cyclone" nozzles, and in modified forms have been used ever since.

The main features of modern cyclone nozzles are the strainer, whorl-plate, whorl-chamber, and disk (Fig. 2). In passing through oblique openings in the whorl-plate, the spray liquid is given a rotary motion in the whorl-chamber, and on being forced through a circular opening in the centre of the disk is broken into a hollow cone of spray droplets.

For efficient application a wide-angle cone of fine droplets of spray is required with sufficient penetration to reach all parts of the tree. At the same time a sufficiently high rate of delivery is required to enable complete coverage to be obtained in minimum time and without undue wastage. Different workers have shown that the distribution of spray is dependent on nozzle pressure and on the construction of the various nozzle parts. The relationship between the factors involved is summarized in Table I.

Table I.—Summary of Factors recorded as influencing Spray-distribution.

Increase in	Effects on			Volume Delivery.
	Angle of Cone.	Fineness of Droplets.	Depth of Penetration.	
Pressure	Increased (*b*) ..	Increased (*a*), (*b*), (*c*)	Increased (*a*), (*c*) ..	Increased (*a*), (*b*), (*c*), (*e*).
Diameter of disk aperture	Increased (*a*), (*b*) ..	Not affected (*a*) ..	Increased (*a*) ..	Increased (*a*), (*b*), (*c*).
Thickness of disk ..	Decreased (*a*), (*b*) ..	Decreased (*a*), (*b*) ..	..	Decreased (*b*).
Depth of whorl-chamber	Decreased (*a*), (*b*), (*c*)	Decreased (*a*), (*b*), (*c*)	Increased (*a*), (*c*) ..	Increased (*a*), (*b*), (*c*).
Diameter of whorl-plate openings	Decreased (*a*) ..	Decreased (*a*) ..	Increased (*a*) ..	Increased (*a*).
* Angle of whorl-plate openings	Increased (*b*) ..	Increased (*b*) ..	..	..
Number of whorl-plate openings	..	..	Increased (*d*) ..	..

(*a*) Davies and Smyth-Homewood, 1934.
(*b*) Anderson and Roth, 1923.
(*c*) Wright and Woodman, 1932.
(*d*) Hough, 1928.
(*e*) Cardinell and Gaston, 1932.
* The angle of the whorl-plate openings refers to the degree to which they diverge from a right angle to the surface of the disk.

Experiments have been conducted since 1933 with the object of determining the relative significance of nozzle pressure and of the different nozzle parts in their effects on (*a*) the angle of the spray cone and the distribution and fineness of spray droplets, (*b*) the depth of penetration—*i.e.*, distance to which spray is driven, and (*c*) on volume delivery—*i.e.*, volume of spray delivered in unit time.

Angle of Spray Cone and Distribution and Fineness of Spray Droplets.

EXPERIMENTAL METHOD.

Apparatus was designed, similar to that described by Anderson and Roth (1923, p. 153), in which sheets of white paper were exposed to the spray for short lengths of time. The spray droplets formed stippled deposits on the paper in the form of circular bands where the cones

were "hollow" or as infilled circular areas where the cones were "solid." From the spray patterns thus produced the angles of spray cones were measured and the fineness and distribution of spray droplets compared.

Clearly defined patterns were obtained by using a spray mixture consisting of copper-polysulphides prepared by mixing lime-sulphur and copper-sulphate. This proved cheaper to use than soluble dyes, and had the advantage that, although the water from each droplet soaked into the paper, the area covered by copper-polysulphide did not extend, since the latter was not absorbed. The length of exposure was varied as far as possible to prevent the droplets of spray massing together.

An electrically driven power pump was used, adjustments in pressure being made at the pump, and the working-pressure measured by a tested gauge placed a few inches behind the nozzle. The nozzles were held on a rigid frame, provision being made for varying the distances from the sheets of paper.

A cyclone nozzle similar to that shown in Fig. 2 was employed as a standard, with variations in the construction of certain parts. All the whorl-plates used were $1\frac{1}{8}$ in. in diameter and $\frac{1}{8}$ in. thick, but varied in the number, angle, and diameter of the openings. The whorl-chamber was 1 in. in diameter and the normal depth 0·12 in., variations in depth being obtained, where required, by the use of rubber gaskets of different thicknesses. Alterations in the shape of the whorl-chamber were made by means of $\frac{1}{4}$-in. diameter pins projecting from the centre of certain whorl-plates. Disks were $1\frac{1}{4}$ in. in diameter, but varied in thickness and in the diameter of apertures. Unless otherwise stated a disk thickness of approximately $\frac{2}{64}$ in. has been used.

The diameter of each spray pattern was measured as the diameter of a circle passing through the portion of the band of spray in which deposition was heaviest (Fig. 9). Repeated measurements by this method showed that the maximum error was approximately $\frac{1}{2}$ in. Where patterns were uneven the average of several measurements was taken. The relative fineness of spray droplets and their distribution in the spray cone were estimated by comparison of patterns.

RESULTS.

(i) *Pressure.*—The angle of the spray cone increased with increase in pressure up to approximately 100 lb. With further increase up to 300 lb. the angle of the cone, after remaining constant over a short range of pressures varying with the nozzle used, tended to diminish (Fig. 3).

At low pressures the cone was infilled and consisted of coarse droplets of spray. As pressures were increased up to 200 lb. to 250 lb. the band of spray became narrower, the cone progressively more hollow, and droplets of spray finer. With further increase up to 300 lb. the band of spray widened slightly, the droplets of spray became finer, and the centre of the cone partially infilled (Figs. 4, 5, and 6).

(ii) *Disc Aperture.*—With increase in the diameter of disk apertures over a range of $\frac{3}{64}$ in., $\frac{4}{64}$ in., $\frac{5}{64}$ in., $\frac{6}{64}$ in., $\frac{7}{64}$ in., and $\frac{8}{64}$ in., the angle of the spray cone increased. The rate at which the angle of the cone

increased with increasing disc size was influenced by the structure of the whorl-plate, becoming greater as the number or diameter of openings in the whorl-plate decreased or the angle of the openings increased.

As the diameter of the disk aperture was increased, the cone became more hollow and the band of spray wider (Figs. 8, 9, and 10). At the same time the size of spray droplets increased. The later effect was most marked where nozzle pressures were low, and tended to disappear at higher pressures and where the number and diameter of the whorl-plate openings was increased or the angle decreased.

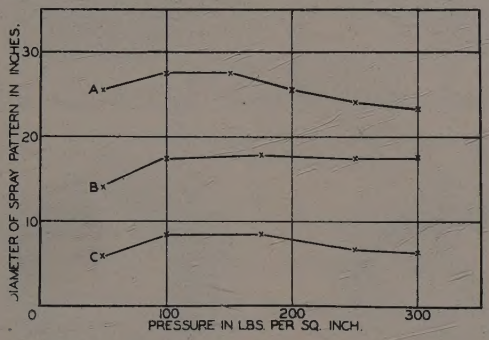

FIG. 3. EFFECT OF INCREASE IN PRESSURE ON THE DIAMETER OF SPRAY PATTERNS PRODUCED 2 FT. FROM THE NOZZLE.

The different curves show the effects produced when using whorl-plates and disks of various construction, as follows :—

Curve A : Whorl-plate with six openings of diameter $\frac{8}{64}$ in. at angle of 67·5° ; disk aperture, $\frac{8}{64}$ in. diameter.

Curve B : Whorl-plate with six openings of diameter $\frac{4}{64}$ in. at angle of 22·5° ; disk aperture $\frac{4}{64}$ in. diameter.

Curve C : Whorl-plate with two openings of diameter $\frac{12}{64}$ in. at angle of 67·5° ; disk aperture $\frac{4}{64}$ in. diameter.

(iii) *Thickness of Disk.*—Increase in thickness from $\frac{2}{64}$ in. to $\frac{4}{64}$ in. narrowed the angle of the cone (Fig. 7, curves C and D) and increased the size of spray droplets. Increasing the thickness to $\frac{6}{64}$ in. did not appear to have further effect. With disks thicker than $\frac{2}{64}$ in., slight variations in the alignment of the apertures caused marked unevenness in the distribution of spray.

(iv) *Depth and Shape of Whorl-chamber.*—Increase in the depth of the whorl-chamber from approximately 0·08 in. to 0·24 in. had no measurable effect on the angle of the spray cone. The band of spray appeared to become slightly narrower and the droplets of spray a little coarser.

The introduction of a $\frac{1}{4}$-in.-diameter pin projecting 0·04 in. and 0·08 in. in the whorl-chamber (of depth approximately 0·12 in.) had no effect on the spray cone other than to cause a slight reduction in the angle.

(v) *Diameter of Whorl-plate Openings.*—Increasing the diameter of the whorl-plate openings from $\frac{4}{64}$ in. and $\frac{8}{64}$ in. and $\frac{12}{64}$ in. rapidly decreased the angle of the spray cone (Fig. 11). The spray droplets became slightly larger and the band of spray wider, tending to form a solid cone.

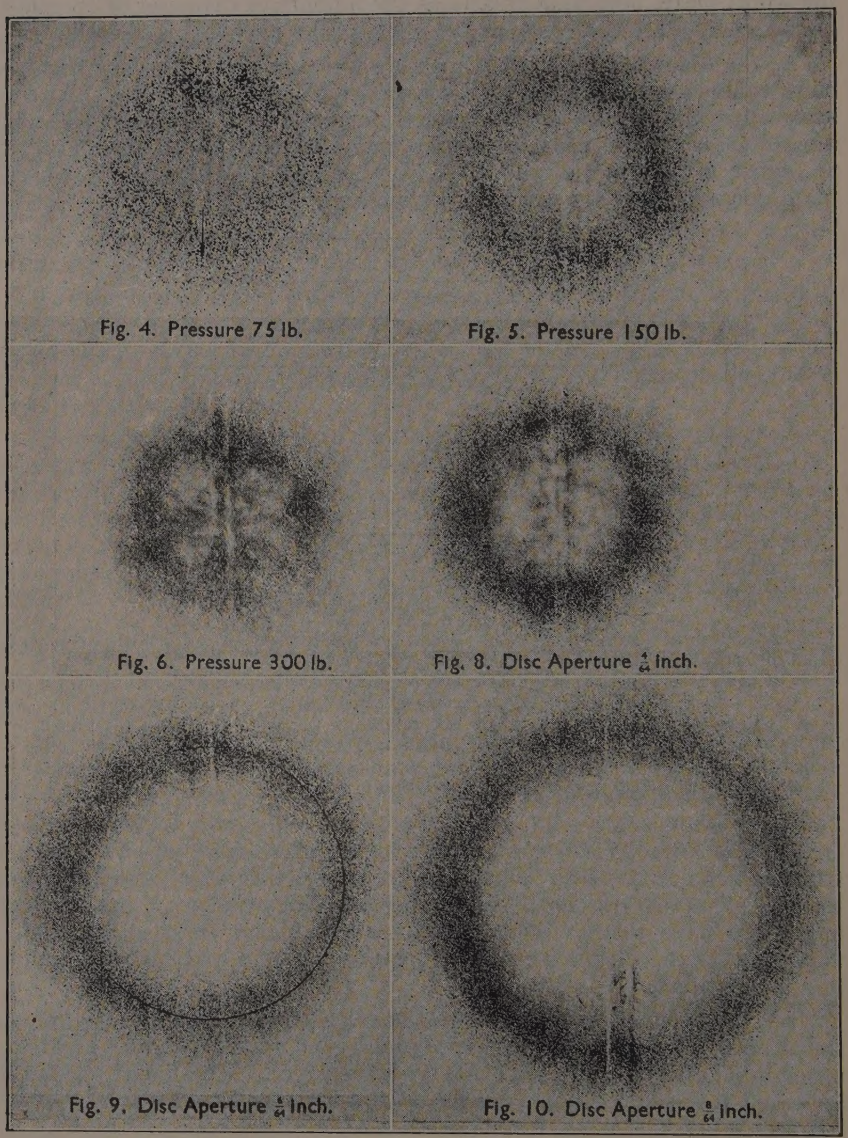

Fig. 4. Pressure 75 lb.

Fig. 5. Pressure 150 lb.

Fig. 6. Pressure 300 lb.

Fig. 8. Disc Aperture $\frac{4}{64}$ inch.

Fig. 9. Disc Aperture $\frac{6}{64}$ inch.

Fig. 10. Disc Aperture $\frac{8}{64}$ inch.

FIGS. 4, 5, AND 6. EFFECT OF INCREASING NOZZLE PRESSURE.

Spray patterns produced at 2 ft. with nozzle having six whorl-plate openings of diameter $\frac{8}{64}$ in. at angle of 45° and disk aperture $\frac{4}{64}$ in. diameter.

FIGS. 8, 9, AND 10. EFFECT OF INCREASING DIAMETER OF DISK APERTURES.

Spray patterns produced at 2 ft. with a nozzle pressure of 250 lb., and whorl-plate with six openings of $\frac{8}{64}$ in. diameter at angle of 45°.

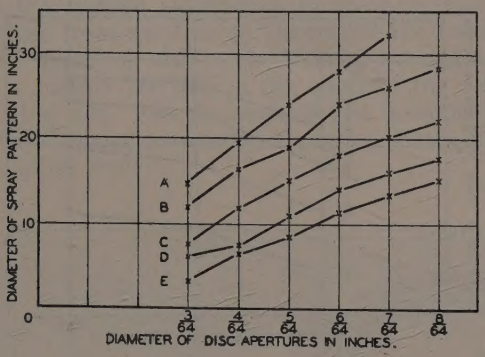

FIG. 7. EFFECT OF INCREASE IN THE DIAMETER OF DISK APERTURES ON THE DIAMETER OF SPRAY PATTERNS PRODUCED AT 2 FT. WITH A NOZZLE PRESSURE OF APPROXIMATELY 250 LB.

The different curves show the effects produced when using whorl-plates of various construction, as follows :—

Curve A : Whorl-plate with two openings of diameter $\frac{8}{64}$ in. at angle of 45°.

Curve B : Whorl-plate with four openings of diameter $\frac{8}{64}$ in. at angle of 67·5°.

Curve C : Whorl-plate with six openings of diameter $\frac{8}{64}$ in. at angle of 45°.

Curve D : Same whorl-plate as Curve C, but disk thickness increased to $\frac{4}{64}$ in.

Curve E : Whorl-plate with two openings of diameter $\frac{12}{64}$ in. at angle of 67·5°.

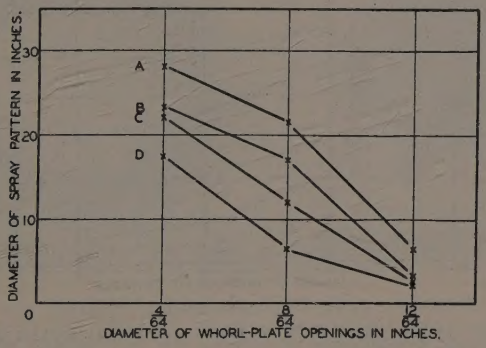

FIG. 11. EFFECT OF INCREASE IN THE DIAMETER OF WHORL-PLATE OPENINGS ON THE DIAMETER OF SPRAY PATTERNS PRODUCED AT 2 FT. WITH A NOZZLE PRESSURE OF APPROXIMATELY 250 LB.

The different curves show the effects produced when using whorl-plates and disks of various construction, as follows :—

Curve A : Whorl-plate with two openings at angle of 67·5° ; disk aperture $\frac{4}{64}$ in. diameter.

Curve B : Whorl-plate with two openings at angle of 67·5° ; disk aperture $\frac{3}{64}$ in. diameter.

Curve C : Whorl-plate with six openings at angle of 45° ; disk aperture $\frac{4}{64}$ in. diameter.

Curve D : Whorl-plate with six openings at angle of 22·5° ; disk aperture $\frac{4}{64}$ in. diameter.

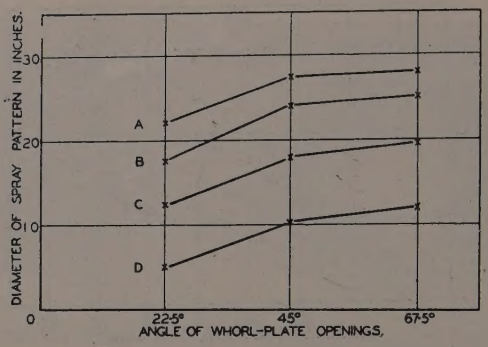

FIG. 12. EFFECT OF INCREASE IN THE ANGLE OF WHORL-PLATE OPENINGS ON THE DIAMETER OF SPRAY PATTERNS PRODUCED AT 2 FT. WITH A NOZZLE PRESSURE OF APPROXIMATELY 250 LB.

The different curves show the effects produced when using whorl-plates and disks of various construction, as follows :—

Curve A : Whorl-plate with two openings of diameter $\frac{4}{64}$ in. ; disk aperture $\frac{4}{64}$ in. diameter.

Curve B : Whorl-plate with four openings of diameter $\frac{4}{64}$ in. ; disk aperture $\frac{4}{64}$ in. diameter.

Curve C : Whorl-plate with six openings of diameter $\frac{6}{64}$ in. ; disk aperture $\frac{6}{64}$ in. diameter.

Curve D : Whorl-plate with four openings of diameter $\frac{3}{64}$ in. ; disk aperture $\frac{3}{64}$ in. diameter.

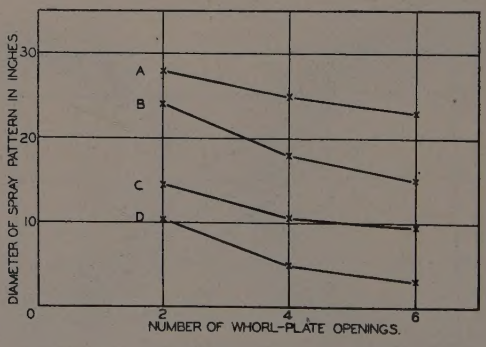

FIG. 13. EFFECT OF INCREASE IN THE NUMBER OF WHORL-PLATE OPENINGS ON THE DIAMETER OF SPRAY PATTERNS PRODUCED AT 2 FT. WITH A NOZZLE PRESSURE OF APPROXIMATELY 250 LB.

The different curves show the effects produced when using whorl-plates and disks of various construction, as follows :—

Curve A : Whorl-plate with diameter of openings $\frac{4}{64}$ in. at angle of 67·5° ; disk aperture $\frac{4}{64}$ in. diameter.

Curve B : Whorl-plate with diameter of openings $\frac{8}{64}$ in. at angle of 45° ; disk aperture $\frac{5}{64}$ in. diameter.

Curve C : Whorl-plate with diameter of openings $\frac{4}{64}$ in. at angle of 22·5° ; disk aperture $\frac{3}{64}$ in. diameter.

Curve D : Whorl-plate with diameter of openings $\frac{8}{64}$ in. at angle of 22·5° ; disk aperture $\frac{3}{64}$ in. diameter.

(vi) *Angle of Whorl-plate Openings.*—Increase in the angle of the whorl-plate openings from 22·5° to 45° increased the angle of the spray cone. When the angle of the openings was increased from 45° to 67·5°, there was a further increase in the angle of the cone, but not to the same extent (Fig. 12). As the angle of the openings was increased the band of spray became narrower, the cone more hollow, and the spray droplets slightly finer.

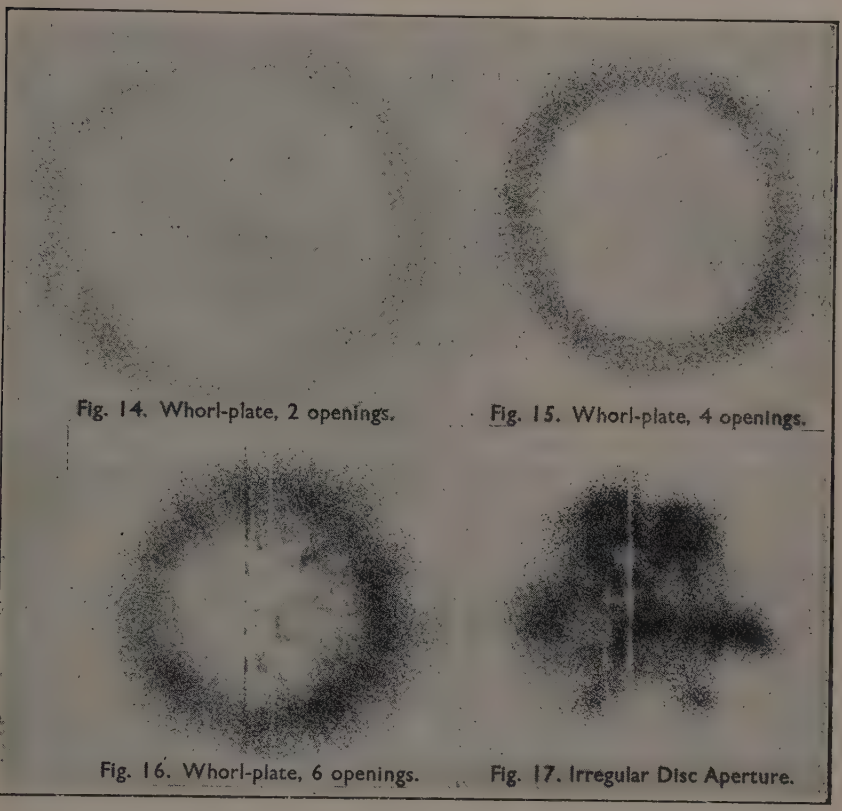

Fig. 14. Whorl-plate, 2 openings.

Fig. 15. Whorl-plate, 4 openings.

Fig. 16. Whorl-plate, 6 openings.

Fig. 17. Irregular Disc Aperture.

FIGS. 14, 15, AND 16. EFFECT OF INCREASING NUMBER OF WHORL-PLATE OPENINGS.

Spray patterns produced at 2 ft. with a nozzle pressure of 250 lb. and whorl-plate with openings $\frac{5}{64}$ in. diameter at angle of 45° and disk aperture $\frac{5}{64}$ in. diameter.

FIG. 17. EFFECT OF IRREGULAR DISK APERTURE ON DISTRIBUTION OF SPRAY.

(vii) *Number of Whorl-plate Openings.*—Increase in the number of openings from two to four decreased the angle of the cone. When the number of openings was increased to six, further decrease in the angle of the cone occurred, but to a less extent. (Fig. 13.) In conjunction with decrease in the angle of the cone, the band of spray became wider, the cone less hollow, and the spray droplets slightly larger (Figs. 14, 15, and 16).

(viii) *Strainer.*—The use of a strainer slightly increased the angle of the spray cone and improved the evenness of distribution, but did not appear to affect the width of the band of spray or the size of spray droplets.

(ix) *Inaccuracies in Construction.*—Any inaccuracies such as disk apertures out of centre or irregular in shape, whorl-plate openings unevenly placed, &c., caused uneven distribution of spray (Fig. 17). Similar effects were produced by partial blockage of whorl-plate or disk apertures.

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(To be continued.)

BEHAVIOUR OF NEW ZEALAND CERTIFIED CLOVERS IN NEW ZEALAND AND ABROAD.

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Two species of clover come under certification. These are—(1) white clover; (2) Montgomery red clover. In both of these there are two classes of seed—(*a*) mother; (*b*) permanent-pasture.

In red clover there is little difference between the type of mother seed and permanent-pasture seed, but in white clover two rather definite types are included. The mother-seed white clover is the tall-growing, large-leaved, highly-producing type which we regard as the very best, for both dairying and sheep-farming, where conditions are such that white clover thrives. The permanent-pasture class includes the mother-seed type "once grown," and also a smaller-leaved, somewhat lower-producing but highly persistent type which is suited excellently for harder sheep-grazing.

Throughout New Zealand 108 trials have been conducted where certified white-clover types have been tried against uncertified types and certified Montgomery red clover has been tried against broad red clover. It is largely on these trials, and on some farmers' experiences, that the following statements are based.

Certified White Clover.

As yet there has been a very limited supply of certified mother seed of white clover. Accordingly, there are relatively few areas which have been sown down with seed of this type. Where this type occurs naturally in Hawke's Bay and in North Canterbury

it provides a remarkable bulk of luscious feed, which is utilized mostly by dairy herds or by fattening bullocks, and, further, where it has been sown in other districts suitable to rye-grass and white clover similarly excellent results are being obtained. Examples of this have been seen in Poverty Bay, South Auckland, Manawatu, Mid-Canterbury, North Otago, and Central Otago. At Ngakuru, in the Rotorua district, a large part of the success obtained on pumice country is due to the use of mother-seed white clover. In the Manawatu, also, this clover establishes and grows particularly well.

The following figures show how the certified types compare with other types when grown with rye-grass in the mowing and grazing trial at Marton. New Zealand No. 1 (mother seed) is taken as 100 in each instance.

	Winter.	Spring.	Summer.	Autumn.	For Whole Year.	
					Relative Total Yields of Grasses and Clover.	Relative Total Yield of Clover only.
New Zealand No. 1, mother seed	100	100	100	100	100	100
New Zealand No. 2, permanent-pasture seed	95	85	90	94	90	65
Kentish Wild White ..	97	82	78	90	86	50
Ordinary New Zealand ..	91	76	81	87	83	44
Imported Dutch	76	62	81	86	75	25

These figures show that in each season of the year the certified types give the best yields of herbage. In the first five columns the yields shown refer to production of both grass and clover, but the sixth column, based on dissection analyses of samples of cut herbage, gives the relative clover-yield.

The superiority of the certified types is most marked at the critical winter and summer periods, and the very early spring growth and quick autumn recovery after a dry summer are valuable qualities. Certified white clover assists tremendously in providing the dairy herd with a supply of succulent feed which can be relied on from season to season and year to year, and the farmer obtains a pasture which grows a thick mat that prevents weed-invasion and deterioration of his pasture.

White clover grown from certified mother seed is proving not only of value for the dairy herd, but also of wonderful assistance to the sheep-farmer. Its growth starts early in the spring, and it gives plenty of feed for early-lambing ewes. Many of the lambs can be fattened off in time to allow the paddocks to be shut up for a seed crop. When this has been harvested, growth soon commences again, and by the early autumn there is again first-class grazing which, during the dry year in the Manawatu in 1935, proved of great value as a green feed for lambs, and it is asserted that where sheep had access to this green feed little or no trouble was experienced with facial eczema in the flock grazing on it.

Where certified white clover has been sown in the South Island, a seed crop is generally sought, but the accompanying benefits of

better growth and a longer period of production, together with recovery after periods of drought, have made it an important grazing-crop as well. If irrigation can be practised, this clover can be used over very wide areas which now are affected by long summer droughts. In Canterbury, particularly, the application of water over the summer months enables a first-class ryegrass-white-clover pasture to be maintained where stunted brown-top and flat weeds previously existed. The resulting clover-growth can be managed either for grazing or for a seed crop.

Certified Montgomery Red Clover.

Montgomery red clover would appear to be valuable from two aspects: (1) As a seed crop for export; (2) as a constituent of the permanent pasture, and possibly as a special-purpose summer-feed pasture.

SEED-PRODUCTION OF MONTGOMERY RED CLOVER.

For seed-production Montgomery red clover has distinct possibilities, but the price of the seed must be brought more in accord with that of the ordinary broad red clover before seed-growing can safely be expanded. Montgomery red clover sets seed well in New Zealand, and, given good seasons and a moderately fertile soil, it yields almost as heavily as broad red clover. Good crops in 1934–35 yielded up to 2 sacks per acre. The highest yields of machine-dressed seed, as shown by the certification records, are as follows: Season 1931–32, 258 lb. per acre; season 1932–33, 160 lb. per acre; season 1933–34, 250 lb. per acre. Most of this seed was grown in South Canterbury and North Otago in seasons marked by drier conditions than usually prevail.

It would appear that Montgomery red clover prefers moist rather than dry conditions, and in this respect demands more moisture than broad red clover. The yield secured at Palmerston North this year from a pedigree strain was 344 lb. of machine-dressed seed per acre. In 1933 a yield of 611 lb. of seed per acre was secured, but this stand was grown under ideal conditions. One hundred and sixty-five acres came into certification in the 1933–34 season, the total amount of machine-dressed certified seed being 17,263 lb., an average of 105 lb. per acre. There was a considerable increase in 1934–35, when 392 acres yielded 32,193 lb. of machine-dressed certified seed.

The practice in seed-production with Montgomery red clover in New Zealand is somewhat similar to that with broad red clover: a hay crop is taken in November to December and the aftermath shut up for a seed crop. It is highly problematical whether this practice of a hay crop is preferable to grazing the stand up till possibly the end of November, but no definite data are available on this point. It has been shown definitely that a stand of Montgomery red clover is readily "smothered" by allowing a dense crop to lodge, and it would appear that a reasonable grazing practice is better for the stand than either haying or seeding. One of the oldest stands of Montgomery red clover in New Zealand is that in the Leeston district sown there by the Canterbury Seed

Co. in 1930. This has been hayed or seeded each year, and in 1934 it produced a very heavy crop. It would appear, however, that reseeding has had a good deal to do with the persistency of this stand.

MONTGOMERY RED CLOVER IN PERMANENT PASTURE.

As a constituent of the permanent pasture Montgomery red clover is worthy of a place, and is to be preferred to the ordinary broad red clover on account of its more persistent nature and less

FIG. 1. PERMANENT PASTURE ON LIGHT, SANDY, AND STONY RIVER-ACCRETION COUNTRY SOWN OUT WITH CERTIFIED PERENNIAL RYE-GRASS, COCKSFOOT, CERTIFIED MOTHER-SEED WHITE CLOVER, AND CERTIFIED MONTGOMERY RED CLOVER.

The growth shown is dominantly Montgomery red clover and white clover. The pasture has got away somewhat owing to the wet summer experienced this season. Photo taken 21/3/36. [*Photo by E. Bruce Levy.*

inclination to get out of hand in the first and second years of the life of the pasture. The price of the seed, however, must conform more to the price of broad red clover than it does at present before a general use will be made of this species as a pasture constituent. Montgomery red clover is essentially a summer pasture-plant, and it would appear as if this is its greatest *rôle* in the pasture. In this respect it may serve well as a dominant constituent of special summer pastures that are managed so as to give optimum growing-conditions for Montgomery red clover—*i.e.*, grazed during the spring and then spelled, and reserved to fill the summer need, the spelling coinciding with the period of optimum

growth for this red clover. Special pastures of cocksfoot, Montgomery red clover, and certified mother white clover may prove invaluable for this summer grazing.

ESTABLISHMENT.

Field-plot trials show that establishment of white and red clover is extraordinarily uncertain, especially where dry conditions have followed the sowings. In Canterbury, for example, in 1930, 1932–33, and 1933–34, with spring sowings very poor establishment of clover has resulted. Spring sowings in North Island districts subject to drought failed also in 1934.

FIG. 2. PERMANENT PASTURE ON LIGHT, SANDY RIVER-ACCRETION COUNTRY SHOWING WONDERFUL GROWTH OF CERTIFIED MOTHER-SEED WHITE CLOVER AND MONTGOMERY RED CLOVER.

The wet summer has contributed greatly to this sward. Photo taken 21/3/36.

[Photo by E. Bruce Levy.

Consolidation of the seed-bed is a vital factor in clover-establishment. This has frequently been shown in our trials where the small area sown could not be rolled. Late autumn sowing—after the end of March—prejudices the chances of a good clover strike. It would appear that autumn sowing, in both North and South Islands, where dry summers are experienced, is distinctly preferable to spring sowings where clovers are concerned. Spring sowing is successful in districts of high rainfall, or where summer droughts are not experienced.

In sowing down for dual seed-production it is essential that both the certified perennial rye-grass, and the certified mother-seed

of white clover establish. When the stand is allowed to run to a rye-grass seed-crop the first year, and heavy lodging occurs, the white clover sown may be entirely smothered out, and subsequent ingress of an inferior type of "volunteer" white clover would give disappointing results and cause some concern when the clover crop was rejected for certification on account of being of inferior type.

From the foregoing remarks it will be seen that clover-establishment in dry areas, and in Canterbury and Central Otago particularly, is a problem requiring serious consideration.

FIG. 3. PERMANENT PASTURE ON HEAVY CLAY WETTISH COUNTRY THAT IS INCLINED TO RUN BACK TO BROWN-TOP AND RUSHES.

Photo shows the growth possible here using certified mother-seed white clover and Montgomery red clover in the mixture. Photo taken 21/3/36.

[*Photo by E. Bruce Levy.*

Effect of Clover on the Grasses of the Sward.

During the course of strain trials throughout New Zealand, ample evidence has been secured relative to the beneficial effect that clover has on the associated grasses of the sward, and instances have been recorded where the differences could be measured in terms of ammoniated superphosphate—*i.e.*, the plots sown with good persistent strains of certified white clover appeared as if they had been top-dressed with 3 cwt. to 4 cwt. ammoniated superphosphate an acre, as against an appearance of no top-dressing on plots on which bad types of white clover were sown or where clover had failed to establish.

Persistency.

In all trials persistency has been a marked feature of all certified clovers, and it would appear as if this persistency will have an enormous influence in extending the range of the species as far as soil-type is concerned. In the past a great deal was said of certain types of country being unable to "hold" certain species permanently, whereas, to-day, by the use of certified strains, on account of their greater persistency, the same country is being permanently grassed.

FIG. 4. PERMANENT PASTURE ONE YEAR OLD AT TIME OF PHOTO, ON A GOOD RIVER ALLUVIAL SOIL AT MASSEY AGRICULTURAL COLLEGE.

Photo shows wonderful early establishment and growth of certified mother-seed white clover and Montgomery red clover, together with certified perennial rye-grass. Photo taken 21/3/36. [*Photo by E. Bruce Levy.*

Certified Clovers Overseas.

Information regarding the performance of New Zealand certified clovers when grown overseas has been drawn from a summary of reports received from persons or institutions supplied with New Zealand seeds for testing purposes.

In the British Isles the certified types do well, and the growth characteristics seem to be similar to those in New Zealand. In practically every case the mother-seed type is superior to the permanent-pasture type. In Great Britain the New Zealand strains are being recommended freely for use in short-term leys.

From Denmark one report indicates good results, and superiority to Danish "Morso," but another report shows little superiority to Danish strains.

New Zealand strains have proved suitable for the eastern coastal regions of the United States of America and Canada, extending within the latitudes 40° to 50° north. They have grown particularly well in British Columbia along the western coastal region of Canada. Anywhere inland in America or in Canada winters are apparently too severe, and winter killing of clover is general. Although winter killing has occurred in Alberta, Manitoba, Ontario, Quebec, and Kansas, a certain amount of satisfactory growth has been made inland at Ottawa, Maryland, Ohio, and at one place in Northern Ontario.

FIG. 5. PURE SWARD OF CERTIFIED PERENNIAL RYE-GRASS ONE YEAR OLD SHOWING ABSENCE OF WHITE CLOVER.

The herbage was inclined to be harsh and dry, with much dry bottom and inclination to be affected with rust. Compare with Fig. 6.

[Photo by E. Bruce Levy.

India and Burma have tropical climates to which our species are quite unsuited. Fiji and the Hawaiian Islands also are too tropical.

The New Zealand strains have proved excellent for pasture purposes in Tasmania, and are successful on the coastal areas of New South Wales, Victoria, and South Australia. Further inland droughts are the limiting factor unless irrigation is possible.

In South Africa unusual climatic conditions are met. Kenya Colony is in the equatorial regions, but all farming is done at high altitudes—up to 9,000 ft. above sea-level. Some of these parts are relatively cool and moist and have a climate similar to that of our North Island, so New Zealand clovers can be grown there.

In the Orange Free State and Natal, in South Africa, the summer is the rainy season, and the winters are dry and cold. Farming there is done at altitudes up to 6,000 ft., and in some parts irrigation is necessary in the winter months. Mother-seed white clover has proved particularly hardy under these conditions, and helps materially in providing winter feed.

Summarizing fifty-five replies received from overseas testing-stations, at twenty-four places certified clovers did well or excellently; at fifteen places, moderately well; at fifteen places, badly; and at one place the test was inconclusive.

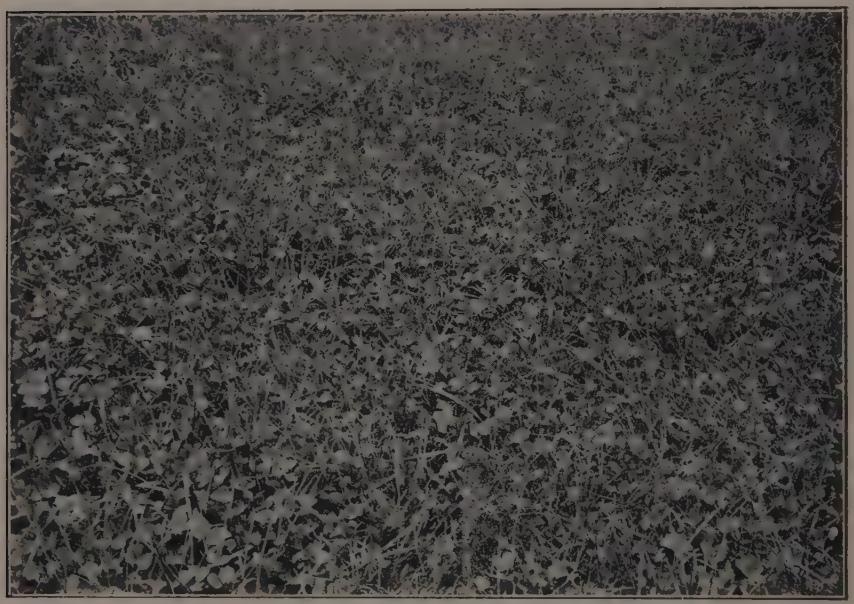

FIG. 6. SHOWING SWARD OF CERTIFIED PERENNIAL RYE-GRASS AND PEDIGREE WHITE CLOVER SAME AGE AND SOIL TYPE AS PASTURE SHOWN IN FIG. 5.

The presence of the clover has improved the health and quality of the rye-grass, which is fresh and vigorous, and the two together have given a high production and highly palatable sward. [*Photo by E. Bruce Levy.*

Few overseas stations have tested New-Zealand-grown Montgomery red clover, but reports received indicate that it thrives in the same situations as those already mentioned as being where certified white clover will grow. The one exception is Ottawa, where red-clover plants are very susceptible to disease and winter killing. Three British plant-testing stations state definitely that the New-Zealand-grown Montgomery red clover is indistinguishable from British-grown Montgomery red clover.

Conclusion.

In regard to New Zealand certified white clover, all available evidence goes to show that in certified New Zealand mother-seed white clover, and pedigree selections of this type, New Zealand

has a valuable pasture-plant, and its advent is of equal importance to that of certified perennial rye-grass. As a pasture-plant it is most useful; and the encouraging overseas reports on this type go to show that its seed is a valuable, readily exportable commodity. In the case of Montgomery red clover, every effort should be made to exploit the British market as an outlet for New-Zealand-grown certified seed of this species, and an endeavour should be made to bring the price more in conformity with that of broad red clover. This would have a marked effect on its wider use in New Zealand itself.

FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

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VI. THE CAPE COLVILLE PENINSULA.

THE Cape Colville Peninsula(30) may be said to extend from Cape Colville to Te Aroha (strictly speaking the peninsula is terminated by a line drawn between the mouths of the Waihou and Tairua Rivers); from Cape Colville to Te Aroha the peninsula has a length of eighty miles and an average breadth of fifteen miles. The land surface is rugged and broken, and the mountains of the main divide rise to an elevation of 2,000 ft. to 3,000 ft. The highest mountains are Moehau (2,900 ft.) in the extreme north and Te Aroha (3,126 ft.) in the south. There is very little flat or gently undulating land. On the east coast the land is penetrated by a number of inlets and tidal estuaries of the larger streams: inland of Mercury Bay, on the north side of Whitianga Harbour, there is a plain of some five miles by two miles in extent, and lesser flats occur in the stream valleys of Tairua and Whangapoua Harbours. The Waihi Plain, in the south-east of Ohinemuri County, is six to seven miles in length east to west and three to four miles across, but is not alluvial in origin. On the west side of the peninsula inlets and tidal streams are absent, or the latter are only tidal for a short distance: at Coromandel there is an area of 2,000 to 3,000 acres of flat land fringing the harbour, and further farming-land extends up the Waiau Valley. The oldest rocks of the peninsula are argillites and greywackes, which were covered by volcanic eruptions in the Tertiary period, first by vast accumulations of andesitic tuffs, breccias, and lava-flows, and finally, at the end of the period, further eruptions covered large areas with rhyolite. Most of the soils are formed from semi-basic or acidic volcanic material(30).

The climate of the Colville Peninsula is very similar to that of North Auckland. The rainfall varies, depending on the configuration of the land, but the mean annual rainfall is probably about 50 in.; Waihi has a mean annual rainfall of 87 in.

Originally most of the country was heavily forested; the kauri-pine, as in North Auckland, covered large areas. The exploitation of kauri-timber, kauri-gum, and gold on the Colville Peninsula has given employment to large numbers of men for many years, has enriched

Auckland City, but has left merely the "bare bones" of land on the peninsula. The felling and removal of the kauri-pine caused the destruction of most of the original forest; the gum-digger followed, and he burnt to clear for his digging operations. Secondary growth

FIG. 13. MAP SHOWING COROMANDEL, THAMES, AND OHINEMURI COUNTIES.

followed repeated burning, and now most of the peninsula is in stunted manuka scrub. Farm lands occupy only a small part of the area; dairying is carried on on the flat and gently undulating land; sheep-farming on danthonia hill-pastures, chiefly on hills the soils of which are derived from andesitic rocks.

*Table VIII.—Crops and Live-stock: Table showing Areas in Crops and Pasture and Numbers of Live-stock in Cape Colville Counties, 1933–34 Season.**

County.	Crops.			Live-stock.			
	Annual Crops.	Pasture.	Pasture cut for Hay and Silage.	Dairy Cows.	Other Cattle.	Sheep shorn.	Pigs.
	Acres.	Acres.	Acres.				
Coromandel ..	365	72,980	611	6,305	9,305	57,369	1,500
Thames ..	621	31,374	2,227	10,862	6,195	10,753	3,730
Ohinemuri ..	1,198	50,692	6,006	19,230	12,020	10,518	7,269
	2,184	155,046	8,844	36,397	27,520	78,640	12,499

* From Agricultural and Pastoral Statistics.

The extension of farming on the peninsula is dependent on the establishment and maintenance of hill pastures of danthonia. If the rainfall were less or the summers generally dry this could be done on most of the andesitic country. This land is dry in the summer: with a run of dry summers and burning, the danthonia pastures can be kept clean and the danthonia area extended. A wet summer means no burning or poor burns and a rapid invasion of manuka and bracken fern. Most of the country is more suitable for forests than pastures, and the establishment of large State forestry plantations at Whangamata may be the beginning of the reafforestation of the peninsula. The alternative to danthonia pastures and burning is the establishment of mixed pastures of grasses and clovers with the aid of phosphatic top-dressing—high farming—but most of the hill country is too high, steep, and broken for this course ever to be payable.

COROMANDEL COUNTY.

21st January, 1936: Coromandel to Te Rerenga.—The road from Coromandel to Whangapoua Harbour crosses the main divide over the Whangapoua Saddle (1,140 ft.) and then follows the valley of the Waitikauri Creek to Te Rerenga. Surface-sown hill pastures in the valleys consists of danthonia, brown-top, and *Eragrostis Brownii*. Farmers are becoming anxious over the continuous wet summer weather, which will prevent or spoil hill-country burns. Whilst a wet summer means plenty of feed on dairy-farms, it prevents the peninsula farmers getting clean burns. All through these danthonia pastures are small manuka seedlings, which, if not burnt off, will grow and increase, and the hills will revert to 4 ft. to 5 ft. dense manuka, which will require cutting and reseeding to get the land back to pasture. Manuka and bracken fern are here the chief secondary-growth plants; hard fern and water fern and piripiri are not troublesome, as on the Western Upland. With regular burning an almost pure danthonia sward is maintained. This system does not allow clovers and better grasses to associate with the danthonia. Production from pure danthonia swards is low, but they are probably the most economic pastures for this class of

country, and are used for grazing Romney sheep, the marketable products being wool and store sheep. For the year ended the 30th April, 1935, the flock sheep for Coromandel and Thames counties consisted of—

County.	Wethers.	Breeding-ewes.	Dry Ewes.	Lambs.
Coromandel ..	6,554	41,514	812	17,486
Thames	1,090	7,357	139	2,548

With the advent of good roads, farm-development will probably follow the lines of first improving the easily ploughable land in the river and stream valleys. Here in the valleys behind Whangapoua Harbour are many hundreds of acres of flat and easily ploughable land that could be developed to grow good pastures of rye-grass, paspalum, and white clover if top-dressed. Some areas are now in paspalum and white clover, and other areas are in danthonia and brown-top. Development of these flats would help to increase the winter carrying-capacity of the farms and give more stock for the spring and summer grazing of the hill country. At both Coromandel and Mercury Bay areas of flat land have been developed for dairy-farming, and higher prices for wool and store sheep and cattle may induce the development of other areas for sheep-farming. From the flats at Te Rerenga, Castle Rock (1,724 ft.), lying at the head of the Opitonui Creek, makes a striking feature of the landscape: the mountain rises from a comparatively low saddle, having an elevation of 1,080 ft., at first with moderately steep slopes and finally with precipitous cliffs for the upper 400 ft.

THAMES COUNTY.

22nd January, 1936: Tapu to Hikutaia.—From Tapu to Thames the road follows the coast; there is little ploughable land, but many of the foothills are danthonia-pasture land. The most fertile and closely settled portion of the county lies between Thames and Hikutaia, and consists of a narrow strip of land between the mountains and the Waihou River. The farming-lands consist of gently rolling foothills merging into flat alluvial land on the banks of the river. A wet day, with wind and driving squalls of rain. Everywhere hay is lying out; most of it spoilt; in places the damaged hay has been raked up and burnt. A great deal of hay has been lost this season all through the Auckland Province. About here paspalum is a common pasture-plant and paspalum fields are throwing a great deal of feed, and the surplus growth could well be made into silage. There are also numerous patches of maize for autumn green feed, which, if the season continues wet, will not be required. Annual crops for summer and autumn feeding are generally satisfactory in a normal year, but in a very dry year they fail, and in a wet year like the present they are not required.

OHINEMURI COUNTY.

23rd January, 1936: Hikutaia to Waihi.—The farming conditions from Hikutaia to Paeroa are generally similar to those just described from Thames to Hikutaia. The Waihi Plain is a flat to gently undulating area about six miles long by four miles wide; the soil is light and was

originally covered in fern and manuka. The farm lands have been developed since 1912. Ploughed, grassed, and phosphated, the land carries fair pastures, but recently experimental work has shown that a strong white-clover growth is dependent on potash manuring. The rainfall at Waihi is 87 in. per annum, and this may account for the potash deficiency. In top-dressing practice potash is not nearly as important as phosphates. On most soils white-clover growth is dependent on phosphatic manuring: some soils require lime in addition to phosphates, and, again, other soils also require the addition of potash. Broadly speaking, potash top-dressing is required only on soils which will not grow legumes well without its aid. Here at Waihi the potash responses are most marked in the vigour and growth of white clover and *Lotus major* (with a corresponding vigour and growth of perennial rye) in colour of the pastures and palatability of the herbage: plots and fields dressed with potash are now closely grazed, whilst the undressed areas carry much seed-head.

VII. Farm Management.

Our journeys through the farming districts of the Auckland Province have covered many hundreds of miles, and we have seen and discussed many things—topography and climate, soils and pastures, crops and live-stock, and methods of farming. With a warm and humid climate, Auckland conditions are suitable for grass-farming. In some respects the soils are peculiar: areas of the older soils have been badly leached—*e.g.*, the gumland and ironstone soils of North Auckland. Over large areas the soils are composed of volcanic ash showers, and, with the exception of comparatively small areas, all soils are deficient in available phosphates, many in lime, and some in potash. Profitable farming is dependent on building up soil-fertility by top-dressing and stocking. High-class pastures and high-class stock (the dairy cow and the breeding-ewe) are the aim—not, of course, always secured, for soil, climate, topography, finance, the value of farm-produce, and the inherent difficulties of grass-farming may one or all lead to a low level of farming. On the steep hill country high rainfall (and often a soil of good moisture-holding capacity) brings trouble in the form of secondary growth. High rainfall and high farming on the flat and undulating land make profitable the dairying and stock-fattening farm enterprises, but the steep hill-country could be better farmed if the rainfall was lower and stable pastures of danthonia and brown-top covered all the high country.

Crops and Pastures.

There are in the North Auckland and South Auckland Land Districts seven million acres in occupation, of which four and a third million acres are cultivated; of the cultivated land nearly four million acres are in the pasture and only eighty thousand acres in annual crops. Pasture-land consists of surface-sown pastures and pastures on ploughed land; the former are situated on hill country originally covered in bush, fern, and scrub, and on drained swamp land; the ploughed grassland is on flat to undulating country originally in fern or scrub, or bush country felled many years ago and subsequently stumped and ploughed. Hill-country pastures vary considerably in composition and productivity. Danthonia and brown-top are the important constituents of most hill pastures, and with these plants are found perennial rye-grass, crested

dogstail, cocksfoot, paspalum, Chewings fescue, ratstail, white and suckling clovers, along with numerous weeds. These pastures are used mainly for grazing Romney sheep and beef cattle. Sheep are the main stock, but about one cattle beast to every ten sheep has to be carried to control pasture-growth and crush out second growth, for fern, manuka, and piripiri are the bane of the hill-country farmer. Pastures on ploughed land also vary considerably in composition and productivity—from pastures of rye-grass, cocksfoot or paspalum, and white clover, producing 200 lb. of butterfat, to pastures producing only 40 lb. to 50 lb. of butterfat per acre, and where one or more of the grasses and clovers such as Yorkshire fog, sweet vernal, goose-grass, brown-top, suckling clover, or *Lotus hispidus* are dominant. Variations are due to soil fertility and management, but the general aim is to secure a pasture in which perennial rye-grass and white clover are dominant, and with which are associated cocksfoot or paspalum. Primarily it is a matter of good establishment and, subsequently, of top-dressing, stocking, and management.

Phosphatic top-dressing is essential on most Auckland dairying and fattening grassland. For the 1933–34 season the following areas were top-dressed in the North and South Auckland Land Districts :—

	Acres.
Fertilizers only	824,426
Lime only	40,935
Fertilizers and lime	448,203
	1,313,564

Superphosphate is the most widely used fertilizer for top-dressing ; on the leached soils, such as those of the podsol type, lime is necessary to get the best results from superphosphate. Basic slag and rock phosphates are also applied : slag was used extensively in the past and would again be used if superphosphate had not a price advantage. Potassic and nitrogenous fertilizers are applied only to a limited extent. Top-dressing is usually carried out annually, using 2 cwt. to 3 cwt. of phosphatic fertilizer, and early autumn top-dressing gives the best results : this increases the autumn and early winter growth of grass, and thus raises the winter carrying-capacity. The effect of phosphatic top-dressing is to increase the white-clover growth. Stocking is important, and it is the stock consuming the clover and grass growth and turning it into manure that finally gives a ryegrass-dominant pasture. The technique of high grass-farming was evolved on the light soils of the Waikato—light soils, yet soils of good summer moisture-holding capacity ; soils that stand heavy stocking without poaching. Attempts to transfer the technique to heavy land are not always successful, for the keynote of success is heavy stocking : wet land poaches badly in the winter, and this leads to lessened pasture-production and the invasion of weeds, particularly buttercup, pennyroyal, and thistles. The introduction of paspalum has, however, made possible high grass-farming on large areas of heavy land, for paspalum forms a strong turf and grows well in the summer : if the summer growth is controlled it combines well with rye-grass and white clover.

The bulk of the supplementary feed for periods of grass-shortage is saved as hay and silage from permanent pastures, and for the 1933–34

season 190,972 acres were saved for hay and 53,235 acres for silage in the North and South Auckland Land Districts. Crops grown were as follows :—

	Acres.
Cereals	15,729
Green and root crops	63,464
Lucerne	4,161

Oats and maize are the two important cereal crops. Oats for chaff and threshing occupied 4,479 acres, and green-feed oats 1,348 acres; maize for grain occupied 4,138 acres, and 4,769 acres were grown for green feed and silage. Swedes and soft turnips occupied 51,031 acres, and the remaining area under green and root crops was composed of rape, kale, chou moellier, mangels, millet, cattle-marrows, and potatoes. The acreage under lucerne is gradually increasing, and the crop will probably be used more extensively in the future on all the light, well-drained land of the province.

LIVE-STOCK.

Auckland farms may be classified according to the class of live-stock grazed and the marketable products produced. Two chief divisions may be made—viz., dairy-farms and sheep and cattle-grazing farms. On the former are grazed nine hundred thousand milking-cows and necessary replacement stock, and on the latter nearly one and three-quarter million breeding-ewes, together with dry sheep, breeding beef-cows, and dry cattle. The live-stock grazed in the North and South Auckland Land Districts during the 1933–34 season were as follows :—

Dairy Cattle, at 31st January, 1934.

Cows in milk	906,280
Cows dry	53,078
Heifers, one to two years	185,060
Calves	190,237
Bulls, two years and over	28,154
	1,362,809

Beef Cattle, at 31st January, 1934.

Cows and heifers, over two years	108,269
Steers, over two years	97,577
*Steers and heifers, one year to two years	77,841
*Calves	85,101
Bulls, two years and over	3,114
	371,902

Sheep, at 30th April, 1934.

Breeding-ewes	1,693,481
Dry ewes	53,014
Wethers	227,067
Lambs	564,478
Rams	46,838
	2,584,878†

* Includes young dairy and beef bulls.

† Auckland Sheep District, which includes Opotiki (Gisborne), Ohura (Taranaki), and Kaitieke (Wellington) counties, had a total of 2,937,554 sheep.

Auckland farming districts are not self-supporting in cattle or sheep. The fat-lamb-raising and cattle-fattening industries of the Waikato draw supplies of ewes, wethers, and cattle from the East Coast districts. In the past large numbers of dairy heifers were brought into the Waikato from Taranaki.

SHEEP- AND CATTLE-GRAZING FARMS.

Sheep and cattle enterprises show considerable variation. Owing to the general high rainfall, most land in the province is potential milk-producing or fattening land if highly farmed, so that there is no sharp district division in sheep and cattle enterprises between farms producing store and fat stock which is found in some parts of New Zealand. Farms may be divided into farms on which both sheep and cattle are carried and farms grazing cattle alone. Again, the sheep-farms may be divided into farms on which the sheep flocks are maintained or partially maintained by farm breeding and farms on which the ewe flocks are maintained by buying-in. The former are represented by farms on surface-sown hill grassland and may, depending on the class of pasture, produce store or fat stock, and the latter by farms with top-dressed ploughed grassland producing lamb, mutton, and beef. In neither class are large sheep flocks the rule, and quite small flocks are more common than large ones. The size of flocks in four large sheep-farming counties are shown below :—

Size of Flock.	Number of Owners in Counties.			
	Raglan.	Waitomo.	Whangarei.	Waipa.
1– 200	47	158	144	121
201– 500	74	171	93	52
501– 1,000	82	115	56	39
1,001– 2,500	82	90	32	33
2,501– 5,000	22	13	5	5
5,001– 7,500	4	3	1	..
7,501–10,000	1	1	..	..

Raglan and Whangarei counties have both extensive sheep-grazing farms on surface-sown hill country and intensive fat-lamb-raising farms on ploughed grassland. Waitomo County has extensive hill-country sheep-farms ; but dairy-farmers there also keep small flocks of sheep for the control of ragwort. Waipa County is a typical fat-lamb-raising county where flocks are maintained by buying in ewes.

In Auckland farming, fat-lamb raising on high-class pasture-land ranks with dairying as a really efficient industry : extensive hill-country sheep-farming is not generally as efficient, owing, in many places, to the climate not being really suited for the maintenance of stable hill-country pastures. Fat-lamb raising is carried on chiefly on the basic volcanic soil areas of North and South Auckland and on the plains of the Middle Waikato Basin. The fat-lamb raiser relies almost entirely on permanent grass : well-managed farms have a carrying-capacity of three to four ewes per acre, and the grassland is usually top-dressed with 2 cwt. of phosphates per annum. Ewe flocks are maintained with annual drafts of four- and five-year-old Romney

ewes: some farmers to avoid annually changing most of the flock add some two-tooth ewes with each annual draft. The ewes are purchased in January and February, put out with Southdown rams at the end of February or early in March: a lambing percentage of 100 is looked for, and usually 90 per cent. of the lambs are sent away fat off their mothers by the end of December. The value of the wool-clip compensates for ewe losses and the loss in value of ewes—usually a price difference of 5s. to 8s. between a breeding-ewe when bought and a fat ewe sold at the end of the season. The fat-lamb raiser usually runs cattle as well as sheep, in order to control the summer growth of grass, using either two-, three-, or four-year bullocks for fattening or dairy heifers.

FIG. 14. MODERN MILKING-SHED, RUAKURA FARM OF INSTRUCTION, HAMILTON.

Dairy-farm organization centres round the milking-shed: the modern walk-through shed, with concrete floors and yards, milking-machines, separator, and ample boiling and cleaning water-supply facilities has made possible the efficient utilization of labour.

[Photo by H. Drake.

DAIRY-FARMING.

Dairy-farm organization centres round the milking-shed: the modern walk-through shed, with concrete floors and yards, milking-machines, separator, and ample supplies of boiling and cleaning water has made possible the efficient utilization of labour. One man with machines can milk up to 30 to 35 cows; a man and a youth, 50 to 65 cows; two men, 80 to 85; and three men, 100 to 110 cows. Hence, on good dairying-land common farm sizes are 50-acre farms milking 30 to 35 cows, 100-acre farms milking 50 to 65 cows, 150- to 200-acre farms milking 80 to 100 cows. Most Auckland herds over twenty cows are milked by machines; in January, 1934, there were 906,280 cows in milk, of which 736,532 cows were milked by machines, there being

12,643 milking-machine plants. The Dairy Industry Commission(31), commenting on "Labour in relation to Production," stated: "Dairying in New Zealand is organized largely on the basis of family labour, the efficiency of which varies considerably. There are, however, instances of one unit of male labour milking up to forty cows, and a range of between fifteen and thirty-five cows per male unit is common. Thus the efficiency of farm labour measured in butterfat output shows wide variations, and may range from 2,700 lb. to 12,600 lb. of butterfat on farms where dairying is the main source of income. High per-acre production of butterfat is, however, generally associated with high labour efficiency. With improved herds and through widespread use of labour-saving machinery, the general level of labour efficiency has has been raised materially during recent years, and to-day 6,000 lb. of butterfat per male unit of labour should be viewed as the minimum for machine-milked herds." A survey(32) of 259 Auckland dairy-farms, with machine-milked herds, gave the following particulars regarding butterfat-production and labour efficiency:—

	North Auckland.	South Auckland.
Number of farms	115	144
Number of cows	6,342	9,934
Average butterfat-production per acre ..	92·98 lb.	143·69 lb.
Average butterfat-production per cow	226·0 lb.	263·2 lb.
Average number of cows per 100 acres	41·4	54·6
Average butterfat per labour unit	4,708 lb.	6,024 lb.
Average cows per labour unit	20·83	23·43

The labour required for milking can do all the necessary farm-work of feeding, pasture maintenance and repairs, but normally requires supplementing during hay and silage harvesting. Machinery has greatly lessened the work of harvesting, and since the introduction of grass ensilage there has been a great improvement in the design of small sweeps for handling grass for hay or silage.

Better winter and early spring feeding of dairy cows would help considerably in increasing butterfat-production on the average Auckland dairy-farm. Good management aims at drying the cows off in good condition in the early winter before grass-growth goes off entirely: if dried off in good condition cows will hold their condition on hay and silage or hay and root feeding, but it is impossible to build up condition in the depth of winter. Supplementary feeding should start in the late autumn or early winter, before it is actually required; if this is done, from a third to a half of the farm can be closed up at the end of May or early June and the grass-growth held over for feeding newly calved cows in July or early August. From the middle of August to the middle of September grass-growth is usually poor; special feed provision for this period consists of temporary pastures of Italian rye-grass, green cereals or permanent pastures top-dressed with ammoniated superphosphate.

In addition to butterfat, pigs are a source of profit on Auckland dairy-farms, and with good management it is possible to secure from 1½d. to 2d. per pound of butterfat from pigs. The chief difficulty in pig-keeping is to regulate the supply of pigs to the skim-milk supply: to make the fullest use of skim-milk the wintering of pigs is often a

FIG. 15. A ONE-HORSE SWEEP.

Machinery has greatly lessened the work of harvesting, and since the introduction of grass-ensilage there has been a great improvement in the design of small sweeps for handling grass for hay and ensilage.

FIG. 16. A PARTIALLY COMPLETED PIT OF GRASS ENSILAGE.

The bulk of the supplementary feed for periods of grass-shortage is saved as hay and silage from permanent pastures, and for the 1933–34 season 190,972 acres were saved for hay and 53,235 acres for silage in the North and South Auckland Land Districts. [*Photos by H. Drake.*

necessity. Wintering is not considered payable, but it is not always possible to arrange littering just when required. (A farmer writes me as follows: "I attempt to get all the sows coming in just before the cows, but in the past eight years only once have I managed it without delayed or some dead litters.") All-grass dairying and root and cereal crops for pig-wintering is a somewhat difficult combination. The Bay of Plenty farmer is solving it with a rotation of swedes and maize: dairy-farms which provide winter roots for cows can winter pigs on roots and meat-meal, but many all-grass dairy-farmers seem to think it more profitable to lose somewhat on pigs and omit all annual cropping. Farm-management is, of course, always a compromise: net income rather than gross income is the test of efficiency.

REFERENCES.

(30) Rocks of the Cape Colville Peninsula, N.Z. Professor Sollas, F.R.S., Vol. I, page 29.
(31) Report of New Zealand Dairy Industry Commission, page 17.
(32) Report of New Zealand Dairy Industry Commission, page 191.

DISTEMPER IN DOGS.

E. L. SIDDALL, Veterinarian, Department of Agriculture, Christchurch.

DISTEMPER in dogs is said to have been introduced to Europe about the middle of the eighteenth century and since that time has gradually spread throughout the world.

True distemper was considered to be found only in dogs or the dog tribe, but within recent years the important observation was made that ferrets are affected by it. Some investigators believed that cats could contract the disease from dogs, or might even convey it to dogs, but the disease from which cats sometimes suffer and which is so like dog distemper in its symptoms is due to a different virus and dogs are not affected by it.

Distemper is a contagious febrile affection generally attacking young dogs three to twelve months old. The parts most commonly affected are the mucous membranes of the eyes and nose, the lungs, stomach and intestines, and the nervous system. Cases have occasionally been noticed in old dogs. One attack of the disease confers immunity, even though the attack has been so slight as to be hardly noticed.

The disease is caused by an ultra-visible and filterable virus which is present in the blood and discharges, and dogs which are debilitated on account of improper feeding, underfeeding, long journeys, bad housing in damp draughty kennels, parasitism, or some disease such as rickets are especially liable to be affected seriously by it should they be exposed to the infection.

Associated with the virus are organisms which are responsible for the secondary lesions. For example, *Brucella bronchisepticus* is the usual cause of distemper pneumonia, and *Escherischia coli*, of which there are many varieties, is commonly held responsible for the alimentary troubles which may occur. These organisms are normally present in the healthy dog, but become virulent in the presence of the virus, and by the debilitated condition of the patient which it induces.

Collecting dogs in communities, such as fox-hound kennels, grey-hound-racing kennels, dog-shows, and, as in this country, dog trials is very often the cause of an outbreak of this disease. The virus is unable to retain its vitality for any length of time outside the animal body, but it is readily transferred from one animal to another. It is easily killed by disinfectants which should be freely used when an outbreak has occurred.

Symptoms.

In the early stages of the disease dullness and loss of appetite are noticed. Temperature rises as much as three or four degrees or more above normal (which is approximately 101° to 101·6° F.). Fever is a very early and prominent symptom. There is discharge from the eyes and nose, which is at first watery but afterwards becomes thicker and eventually, unless frequently removed, closes these parts entirely.

The secondary symptoms show themselves in the form of eye lesions, bronchitis, pneumonia, and inflammation of the stomach and bowels. When bronchitis commences there is a cough, which is at first soft and afterwards hard, dry, and painful, and accompanied by wheezy breathing. If pneumonia supervenes the patient has spasms of painful coughing, which after a time are suppressed as much as possible, and at the same time the breathing becomes very distressed. The discharge from the nostrils is increased in amount and is often blood-stained, and finally the weakness and depression become very marked. If the stomach and intestines become involved there is loss of appetite and great thirst. The animal drinks a large quantity of water which often is soon vomited. When lying down the dog chooses a cold place, such as a piece of oil-cloth or a stony floor. There is a very unpleasant odour noticeable when the mouth is opened and inspected, and the tongue is found to be very furry, and finally blood-stained diarrhœa is seen. Involvement of the brain is shown by periods of excitement followed by convulsions and fits. These symptoms of brain-trouble are generally followed by paralysis, which may affect either one limb or half the body. Instead of this paralysis, a twitching of various groups of muscles may be noticed, causing such movements as champing the jaws or a jerky movement of the head, neck, or limbs.

Treatment.

As this is a disease which must run its course, very careful nursing, assisted by medicine, will give the best results. When the dog is first seen to be off colour it is essential for it to be isolated at once, for preference in a dry warm room which can be kept at an even temperature, with plenty of fresh air but free from draughts. The first treatment for the high temperature is to give aspirin twice daily, estimating the dose at ¼ grain per pound of body-weight. Any signs of constipation should be corrected with medicinal liquid paraffin in doses of a teaspoonful to a tablespoonful twice daily according to size, until the medicine has operated. Without doubt the best diet at this time is fresh milk. Improper feeding with meat and other solid material is very injurious and often accounts for serious complications. Lack of appetite, together with high temperature, is an indication to give only as much as the patient will take voluntarily in the form of milk. Forced feeding is injurious and often causes vomiting. When total loss of appetite persists for several days a few spoonfuls of milk, or liquid meat-extract, should be given every four hours, and to this may be added a few drops of

brandy. After the temperature, which should be taken twice daily, has dropped to normal, and the animal has a good appetite, boiled bread and milk, or boiled rice and milk, may be given. When the patient is put on to a solid diet only small and repeated quantities of easily-digested food are to be given.

The eyes and nose should be kept clean by sponging with warm water in which boracic acid has been dissolved, and afterwards they should be smeared with vaseline or boracic ointment. If the cough be troublesome a few doses of the following mixture should be given: Syrup of squills, syrup of ipecacuana, syrup of chloral, of each 3 drams; liquid acid carbol twenty-four drops, water to 3 oz. The dose is a teaspoonful, dessert, or tablespoonful, according to size of the animal, every few hours. When the cough becomes hard, dry, and painful, inhalation of steam medicated with eucalyptus or Friar's balsam is beneficial. Cover the chest with a woollen jacket to assist in preventing any further complications arising, such as pneumonia, which generally ends fatally in spite of all treatment. Vomiting can be treated by giving a mixture of bismuth carbonate, or bismuth subnitrate, in 5 to 10 gr. doses, together with a similar quantity of bi-carbonate of soda, two or three times a day.

A word of caution is necessary to the dog-owner to be careful to distinguish the early symptoms of distemper from the idea that the animal is suffering from worms, as many dogs have been killed through the indiscriminate use of worm medicines in the early stages of distemper. In distemper the temperature is raised, but this is not usually so in a case of worm-infestation.

After recovery from an attack of distemper it is important to remember that the dog should be treated with great care or else, in many cases, a relapse will occur. For a week to ten days after all symptoms have apparently subsided the food and exercise should be limited and only increased very gradually.

Vaccine for the prevention of this disease has been used with great success in England and elsewhere for some years past, but is exceedingly difficult and costly to prepare. Efforts to obtain supplies from England for use in New Zealand have failed until recently, owing to the vaccine deteriorating during the long journey out. This difficulty has now been overcome, and it is expected that this very valuable means of preventing distemper will be available to New Zealand dog-owners almost immediately. Supplies will probably be limited for a time, but no doubt will increase as the demand for it grows.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 18th June, 1936, to 30th July, 1936, include the following of agricultural interest:—

No. 74646: Milking-machine pulsator; T. A. Rowe. No. 74665: Preserving fruit; W. J. H. Hinricks. No. 75654: Milk-product; Milk Processes Inc. No. 76029: Horse-shoe; T. S. Andrews and W. G. McDowell. No. 74576: Teat-cups; T. Shiels. No. 74578: Weed-killing; D. B. Lloyd. No. 74757: Log-splitting; W. Stubbs. No. 74899: Cream-can lid; W. Harvey. No. 76120: Separator; Aktiebolaget Separator. No. 76125: Fertilizer-distributor; G. H. Baucke. No. 74130: Hay-stacker; T. H. Lawn. No. 74471: Nozzle for flame-thrower; J. McL. Donald. No. 74812: Manure-distributor; L. D. Chambers.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

BROWN-HEART (MOTTLED-HEART) IN SWEDES.

REPORT ON FIELD TRIALS WITH BORAX.

Fields Division.

THE disease known as brown-heart or mottled-heart of swedes has been prevalent in New Zealand for many years, more particularly in Westland, where during the past fifteen years it has become increasingly troublesome. In this district a certain amount of control has been obtained by the use of wood ashes, and many clean crops have been grown following such treatment. Mr. R. McGillivray, Fields Superintendent, Christchurch, reports, however, that the influence of wood ashes does not appear to be so effective in Westland as it was ten years ago, and a recent inspection disclosed a high percentage infection of brown-heart on some crops where ashes had been used.

Neill(1) on his return from Europe stated that a disease similar to the one known as "mottled-heart" was prevalent in Europe and Canada under the name of brown-heart, and that satisfactory control was being obtained by the use of boron compounds. Subsequently there appeared numerous reports of experiments conducted overseas in which borax and other compounds of boron were shown to be effective in the control of the disease. Hill and Grant(2), working in Canada, showed definitely, by means of water cultures and chemical analyses of diseased roots, that there was an inverse relationship between the amount of boron supplied and the occurrence of the disease, and that the latter was associated with low boron content of the roots. O'Brien and Dennis(3 ; 4) reported success in the control of brown-heart (known in Scotland as "raan") by the use of borax under actual field conditions.

In order to ascertain whether similar control methods could be adopted in New Zealand, field-work was commenced by this Division in the spring of 1935, and experiments were laid down on sixteen farms in various parts of the Dominion.

SYMPTOMS OF BROWN-HEART.

The symptoms of the disease are described by Mr. Neill as follows :—

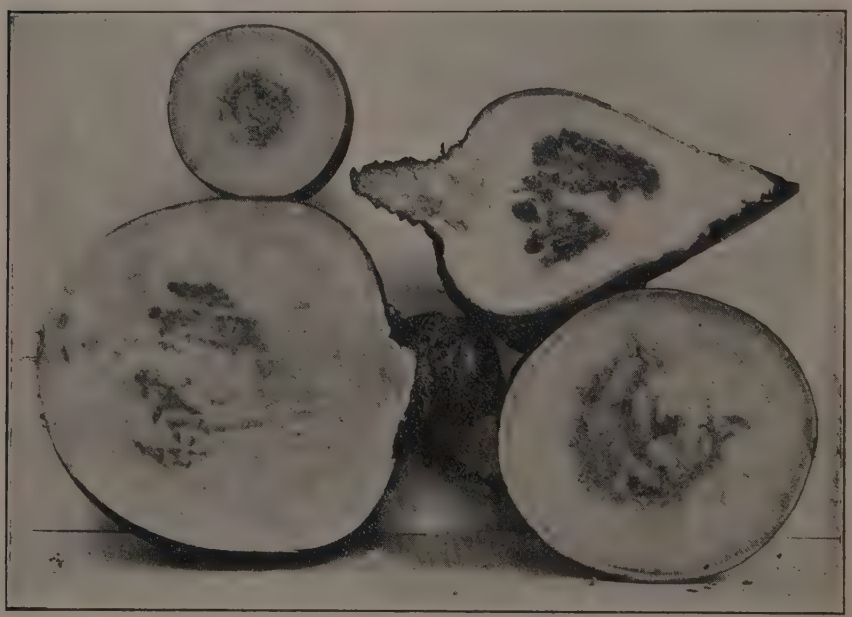
"Swede plants show no outward indication of the presence of brown-heart, but, when cut, irregular brown areas of tissue are seen grouped about the central axis of affected bulbs. This brown tissue has a somewhat water-soaked appearance, and is tough and bitter when eaten. Affected bulbs are consumed, apparently normally, by stock. When cooked they become hard and tasteless.

"Analyses carried out in Scotland(3) showed an increase of 2 per cent. in fibre and a decrease of 3 per cent. to 4 per cent. in soluble carbohydrates in affected swedes. In general, affected bulbs appear to keep normally, but in certain localities, especially the West Coast of the South Island, the affected tissues become invaded by rotting organisms resulting in early and rapid soft rot."

Sections of infected roots are shown in the figure on following page.

Methods used in Trials.

The treatment consisted of mixing 10 lb. per acre of commercial borax with sufficient fertilizer to sow an acre. The treated area was compared with the farmer's crop alongside treated with the same fertilizer, but which had not received borax. A wide range of fertilizers, both in kind and quantity, was used by the various farmers and the method of sowing varied from the 14 in. rows usual in the North Island to the 26 in. ridged drills common in Southland. Under the latter method portion of the fertilizer and borax was in contact with the seed, while part was sown below the seed.



SWEDES AFFECTED WITH BROWN-HEART.

The top right-hand swede is a white-fleshed bronze top; the remainder are yellow-fleshed swedes.

Effect on Germination or "Strike."

In three experiments a detrimental effect on germination was noted from the use of borax, while in one experiment, in Central Otago, the germination appeared normal until the crop was in the three-leaved stage, when about 50 per cent. of the borax-treated seedlings turned brown and died.

In four other trials there was a slight reduction in the number of plants on the treated area.

In Experiment 4 counts were taken of bulbs present in the mature crop, there being an average of thirty-eight present per half-chain on the borax-treated area as compared with forty-eight on the control, a decrease of 20 per cent. The control area was thinned in the usual way, but the borax plot did not require thinning.

Effect of Borax on Brown-heart.

The following table shows that in the majority of trials satisfactory control of the disease was obtained by the use of borax. Details of methods of sowing and germination injury (if any) are also given.

Table I.—Effect of Borax mixed with Fertilizer (at various Quantities) on Germination and Control of Brown-heart.

Location of Trial.	Method of Sowing.	Amount of Borax and Fertilizer per Acre sown.	Effect of Borax on Germination.	Incidence of Brown-heart.	
				On Borax-treated Plot.	On Control Plot.
				Per Cent.	Per Cent.
1. W. Southland	14 in. drills	10 lb.–1⅓ cwt.	Detrimental	Nil	Nil
2. W. Southland	26 in. ridges	7½ lb.–1½ cwt.	Slight ..	Nil	80
3. E. Southland	26 in. ridges	10 lb.–3 cwt.	Detrimental	48*	81
4. E. Southland	26 in. ridges	10 lb.–3½ cwt.	Detrimental	36	63·4
5. S. Otago ..	26 in. ridges	10 lb.–2 cwt.	Nil ..	Nil	Nil
6. C. Otago ..	14 in. drills	10 lb.–2 cwt.	50% seedling mortality	Nil	95
7. Westland ..	28 in. drills	10 lb.–4 cwt.	Retarded ..	Nil	100
8. Westland ..	28 in. drills	10 lb.–3 cwt.	Nil ..	Nil	100
9. Westland ..	28 in. drills	10 lb.–2 cwt.	Nil ..	Nil	100
10. Poverty Bay	14 in. drills	10 lb.–2 cwt.	Slight ..	Trace	10–20
11. Poverty Bay	14 in. drills	10 lb.–2 cwt.	Nil ..	10–30	70–80
12. Taranaki ..	14 in. drills	10 lb.–5 cwt.	Nil ..	Nil	Nil
13. Rotorua ..	14 in. drills	10 lb.–3½ cwt.	Nil ..	16	82
14. Rotorua ..	14 in. drills	10 lb.–2½ cwt.	Nil ..	Trace	Much
15. Waikato ..	14 in. drills	10 lb.–3 cwt.	Slight ..	2	20
16. Waikato ..	26 in. ridges	10 lb.–2¼ cwt.	Nil ..	Nil	Nil

* Only slightly affected.

In six trials complete control of brown-heart was obtained from the use of borax, while in six other trials the disease was considerably reduced. In the remainder of the experiments no brown-heart was noted. In view of the statements of O'Brien and Dennis(4) to the effect that heavy applications of lime tend to increase the susceptibility of swede crops to brown-heart it is of interest to record that in Trial 4 where the least control was obtained from the use of borax, the land was dressed with carbonate of lime at 2½ tons per acre before the swede crop was sown.

Properties of Boron.

Boron never occurs free as an element, but in combination usually as boracic (boric) acid and in several minerals, such as crude borax or tincal, boracite, boronatrocalcite, hydroboracite, colemanite, rhodizite, sassolite, and botyrolite. As an element it is generally distributed throughout the earth's crust. Certain countries—*e.g.*, California, Germany, Persia, Tibet, Bolivia, China, Argentine, and Chile—have commercial deposits of importance.

Minute quantities of boron compounds are found in mineral waters, sea water, in plant shoots and ashes, and in animal and vegetable products. It is also present in minor quantities in the soil. In human and animal tissues it is most easily detected in hair, bones, liver, and muscles.

In plant nutrition a small amount is necessary for the health and growth of plants. Boron belongs to the group of minor elements of plant nutrition. In large amounts it is severely toxic to most forms of vegetation. However, there seems to be some evidence that below a certain limit of concentration boron exercises a favourable influence on plant-growth, encouraging the formation of stronger roots and shoots.

There does not appear to be any evidence yet that the amount of boron contained in plants making normal growth is insufficient for the needs of animals. When introduced in small quantities into the stomach of animals it is apparently not assimilated, but is thrown out in the urine and other secretions.

Boron is used at present in industry only in the combined state as boracic acid or as borates such as borax ($Na_2B_4O_7.10\ H_2O$). Borax (sodium borate*) is prepared from either boracic acid or from some of the crude minerals, such as boronatrocalcite, mentioned above, by treatment with washing-soda. At Searles Lake, in California, large tonnages annually of borax and potash fertilizer salts are separated by selective crystallization from other soluble substances from the same lake brine.

In the thermal region of Tuscany, Italy, large quantities of borax have long been made from boric acid recovered from natural steam springs or fumeroles and artificial well borings in the ground.

A few of the main properties of borax are: It is a white crystalline solid which is readily soluble in water; when heated it loses its associated water of crystallization and passes into a fused glassy mass. It is available commercially in a highly pure state of refinement in powder or crystal form. It forms two types of crystals according to the temperature at which it is crystallized out of solution.

In the household borax is valuable as a mild, alkali antiseptic and for cleaning clothes, dishes, &c. It softens water, neutralizes acids, and has many industrial applications—*e.g.*, in glazing, enamelling, and in manufacture of glass, soldering, soapmaking, dressing leather, preserving wood, &c. It is also used as a food preservative where its use is permitted by law.

In the extension of its use to agriculture the relatively small quantities required will no doubt be provided at comparatively low cost.

Methods of applying Borax.

In addition to the trials described above, four farmers in Westland used borax on portion of their crop, and the Fields Instructor, Greymouth, had an opportunity of inspecting these and estimating the incidence of brown-heart. In three cases no brown-heart was seen in the borax-treated area, whereas the control areas were badly affected. No control of the disease was in evidence on the fourth farm, and both borax treatment and an area dressed with wood ashes alongside were badly affected. One of the successful farmers applied the borax broadcast when the swedes were through the ground, and this is on a parallel with a similar instance in Britain recorded by O'Brien and Dennis(4). Mr. W. Alexander, Field Adviser, Messrs. Kempthorne, Prosser, and

* Also given in chemical literature as sodium pyroborate, sodium tetraborate, and sodium-bi-borate.

Co., Ltd., Auckland, states that at Galatea, where some trials were conducted by the Lands and Survey Department, good control of brown-heart was obtained from applications of 4 lb. borax per acre.

Recommendations made in Britain in regard to the control of brown-heart are for a dressing of 20 lb. of borax per acre to be applied *broadcast over the land just prior to sowing*. In order to get even distribution the borax is well mixed with a spreader, such as dry sand, although it is emphasized that the mixing process should be thoroughly carried out and any lumps crushed prior to mixing. This method of *broadcasting* the material is advocated for market-gardeners and farmers in New Zealand provided that the above precautions are taken. In view of the possibility of germination injury the amount of borax applied should be reduced considerably *when the material is applied with fertilizer*, and when it is realized that drilling in 28 in. rows means a concentration of borax probably seven or eight times that of a similar quantity applied broadcast it becomes evident that the rate of application should not be more than 8 lb. per acre, and that thorough mixing of the borax with the fertilizer should be carried out. If the drill is of the ridger type about half the material should be sown with the seed and about half below the seed.

Preparation of "Borated" Fertilizers.

In view of the necessary registration under the Fertilizers Act of special fertilizers containing boron, and taking into consideration the danger of germination injury from the use of excessive quantities of borax, it was agreed at a meeting of those interested that "borated" fertilizers should be registered provided they conform to the following specifications:—

(1) That the boron used in the mixture be in the form of sodium-bi-borate or any other approved source of boron;
(2) That the percentage of sodium-bi-borate (or its equivalent) in the mixture be not greater than at the rate of 2½ lb. per 100 lb. of fertilizer;
(3) That no free lime or any incompatible ingredients be used in the borated mixture;
(4) That the borax used in the fertilizer mixture be finely ground and adequately mixed so as to ensure even distribution when applied to the crop;
(5) That the advocacy of more than 3 cwt. per acre of a borated fertilizer be discountenanced when such fertilizer is being drilled in immediate contact with the seed;
(6) That all bags be marked with the words "Borated mixture for Brown-heart" in addition to the usual brand.

Summary.

(1) Experiments were carried out in the 1935–36 season on sixteen farms to investigate the effect of borax on control of brown-heart, the treatment consisting of mixing 10 lb. per acre of commercial borax with fertilizer and comparing this with the farmer's crop alongside which received no borax.

(2) In six trials complete control of brown-heart was obtained from the use of borax; in a further six trials the incidence of the disease was considerably reduced, while no brown-heart was apparent in either plot in four experiments.

(3) Borax had an adverse effect on the " strike " in four experiments, and due emphasis must be given to the toxicity of the material when applied under certain conditions.

(4) It is suggested that an effective method of supplying borax is to broadcast 20 lb. of material mixed with fine dry sand before sowing the crop. If the material is to be applied with fertilizer and sown with the seed the quantity should not be more than 8 lb. per acre, and in the case of special fertilizer mixtures for turnips the content of borax should not be greater than $2\frac{1}{2}$ per cent.

(5) Since lime applications appear to be incompatible with brown-heart control, such fertilizer mixtures should not contain free lime, and in districts where brown-heart is prevalent liming immediately prior to sowing a swede crop is not recommended for the above reason. This recommendation does not preclude the use of a properly reverted superphosphate in which no free lime is present.

ACKNOWLEDGMENTS.

The field-work in connection with the trials described above was carried out by Instructors in the various districts shown in Table I under the direction of Fields Superintendents at Auckland, Palmerston North, Christchurch, and Dunedin respectively. Thanks are extended to the farmers who co-operated in carrying out the experiments, to Mr. J. C. Neill, of the Mycological Laboratory, for his suggestions and assistance, and to Mr. J. A. Bruce, Inspector of Fertilizers, for notes in regard to the properties of boron.

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—J. W. Woodcock, Crop Experimentalist.

DEPARTMENT OF AGRICULTURE.
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PASPALUM STAGGERS.

C. S. M. HOPKIRK, Veterinary Laboratory, Department of Agriculture, Wallaceville.

IN April, 1935, reports came to hand from North Auckland and from the Waikato that cattle were becoming affected with a form of staggering when grazing on seeding paspalum. The summer had been dry, but feed came away in excessive amount in the early autumn following warm rains. Previous to the nervous derangement in cattle, complaints were made by all having anything to do with paspalum that a sticky fungus which was becoming attached to clothes was present on the seed-head. This fungus was identified as being a species of Fusarium, *F. culmorum*, by the Government Mycologist. Later, at the time of the cattle disturbance, the brown, berry-like fungus known as *Claviceps paspali* was seen in abundance on ripe seed-heads and identified both by Dr. K. M. Curtis, of Cawthron Institute, and Dr. D. G. Steyn, of Onderstepoort, South Africa. From observations over a second season there is some doubt that the sticky stage of fungus growth was all Fusarium, for microscopically much of it appeared to simulate the honey-dew stage of the ergot. It is understood from the Seed Analyst, Mr. N. R. Foy, that in previous seasons there has been no sign of ergotized seed from New Zealand pastures, yet by 1936 all stands of paspalum were visibly affected all over the North Island.

The symptoms were noticed mainly in cattle, but did appear in a few horses. Cows and bullocks developed a trembling of the body, and if moved showed definite ataxia. The action was a jerky one, with definite inco-ordination of movement. Were the animals frightened so that they attempted to run, the inco-ordinated movement resulted in the animals falling over in curious attitudes. Some clonic convulsions were also noticeable at this stage. Once down the cattle lay for a short while, then scrambled to their feet and repeated the performance.

When the animals were left alone, the trembling was not marked: the animals fed and chewed the cud and were able to move forward slowly without any noticeable inco-ordination.

Animals taken off this type of pasture or fed on hay quickly recovered, and no mortality occurred except through accident. Therefore the action of the poisonous principle was apparently one affecting the nerve-muscle endings.

Blood-samples received for analysis showed nothing unusual.

A small amount of the affected seed-head was received at Wallaceville, and two guinea-pigs were fed on the dry, ground-up ergot sclerotia. One received 4 grams in eight days and the other 5½ grams. It seemed that the animals became "jerky" in movement during feeding, but they did not show trembling or any inco-ordination of movement.

During the past summer and autumn, thanks to the courtesy of Stock Inspectors, a large amount of paspalum infested-seed-head still on the stalk was obtained. Roughly, 10 per cent. of the weight was made up of ergot. The stalks and heads were dried so that no other moulds were present in excess, and the seed-head and stalk was fed

FIG. 1. PASPALUM STAGGERS.
Heifer showing results of attempting to run.

FIG. 2. SIMILAR TO FIG. 1.

to two heifers. They received about 2½ lb. gross each per day in hay for eight days. On the sixth day both were noticed to be trembling slightly, and on the seventh day were inclined to sway and tremble, but otherwise appeared to eat well and to be in good health. One animal was slightly worse than the other. On the eighth day the two animals were let out for a forced run. Both showed typical staggers, trembling, and severe ataxia to such an extent that they were unable to run, and fell in extremely awkward attitudes. Feeding was discontinued, and when put out on grass the two animals were entirely recovered clinically by the fifth day. No ulceration of the mouth nor any damage to the alimentary tract occurred judging from close examination and from consistency of fæces and lack of blood-stained mucus covering stools.

A second feeding experiment was undertaken by Mr. L. W. N. Fitch, who sieved off the ergot sclerotia and fed that forcibly and daily to a yearling heifer and to a cow with a calf at foot. He gave 10 oz. of pure ergot to the cow, but without any clinical results, and twenty-one ounces over eight days to the heifer. After the fourth day this heifer showed twitching and, later, violent trembling of the muscles of the body with salivation. On the ninth day she was inclined to stumble, but no true ataxia or clonic convulsion occurred, nor was lameness in evidence.

The heifer was killed on the ninth day. The alimentary tract showed a congested mucosa, but no other lesions could be found. As some looseness of fæces was noticed during the feeding, no doubt it was due to congestion of the mucosa.

During this experiment there was no change in the blood calcium, phosphorus, and magnesium, so that nervous symptoms were not due to a depletion of calcium or magnesium.

Discussion.

There seems some reason to think, therefore, that the typical symptoms of paspalum staggers appear when the young growing stage of ergot is present in the seed-head and that the full-grown sclerotia give slightly different and not such pronounced symptoms of nervous dyscontrol. Seddon, also, in Australia has been able to produce only the trembling symptom with screened paspalum ergot sclerotia, so that one would think there was some difference between the stalk-fed material and the screened.

Rye ergot (*Claviceps purpurea*) has been worked upon by chemists and pharmacologists for thirty years in the effort to find alkaloids and amines having some action on the body. It is probable that little difference exists in the chemistry of the two species *C. purpurea* and *C. paspali*. New Zealand rye ergot has been found to produce 0·34 per cent. alkaloid. Those named alkaloids known up till last year were ergotoxine(1) and ergotamine, which are active, and ergotinine and ergotaminine, which are inactive. The amines were tyramine, histamine, isoamylamine, and acetylcholine, all of which may only be bacterial breakdown products of protein. Last year ergotmetrine(2) was found—a water soluble alkaloid which has the beneficial action required for obstetrical purposes without the production of gangrene due to the contraction of arterioles.

The two main actions of ergot are production of (*a*) gangrene of extremities, and (*b*) nervous disorders.

Gangrene results from interference by occlusion of the blood-supply of the extremities, and with it extravasation of blood into the stomach and bowel may occur. The action is seen with prolonged use of ergotoxine and ergotamine.

Where nervous disorders occur there is interference with the sympathetic nerve system at the myo-neural junction. Small doses of ergot stimulate, but large doses paralyse the motor junction, but, unlike epinephrine, the inhibitory junctions are untouched. This results in ataxia. If serious poisoning occurs, the ataxia increases to clonic convulsion and, finally, paralysis of the respiratory centre.

In the experiment described with paspalum ergot, either insufficient ergot was given to produce gangrene or the alkaloid present was in a form more conducive to the nervous dysfunction.

It is of interest to look back on the work previously carried out in New Zealand with ergot of the rye type (*Claviceps purpurea*).

Gilruth(3) in 1905 tried to produce effects in cattle and sheep with a commercial sample of dried ergot sclerotia, but without any effect. A calf consumed 10½ lb. in forty-five days, and a sheep ate 1½ lb.

Reakes and Reid(4) in 1911 fed liquid extract of ergot without effect, 3¼ pints to one calf and 2 pints to a steer over three months.

Later, Reakes and Reid(5) in 1912 repeated feeding experiments with rye-grass and fescue-seed head in which ergot was very prevalent. Two to three pounds of seed head were given a day. Lameness developed after five weeks, and dry gangrene of the extremities resulted later.

In an effort to produce rye-grass staggers considerable quantities of ergot present in rye-grass-seed screenings were fed to sheep at Wallaceville by Hopkirk(6). No nervous lesions developed, but two of the sheep were killed by the gangrenous effect of the ergot. One had 40 grams of ergot over five days, showing ulceration of the abomasum. The second had 60 grams over six days, and died ten days later with ulceration of tongue and severe enteritis. The remaining two sheep, although dosed with very large amounts over a period of five months, continued normal. They received 500 grams each. Apparently ergot quickly loses its toxicity when kept in open sacks and there is considerable difference in effect on individual sheep.

Summary.

Paspalum-seed head affected with *Claviceps paspali* when fed to cattle produced typical ataxia and clonic convulsions as seen in the field in "Paspalum staggers."

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THE DRY-DUSTING OF CEREALS.

FIELD TRIALS WITH "CERESAN NEW" AND "AGROSAN G."

Fields Division.

An extensive series of field trials was carried out by the Fields Division with "Ceresan New," one of the organic mercury seed dusts, in the 1933–34 season. (J. C. Neill: Field Trials with "Ceresan New," *N.Z. Journal of Agriculture*, May, 1934.)

Since that time the use of both "Ceresan" and "Agrosan G" has increased rapidly, and, in fact, the whole of the wheat and oats, amounting to nearly 2,000 bushels passing through one South Island store, was dressed last season with one or the other of these compounds, copper carbonate being entirely displaced. In addition, it is reported that many farmers are doing their own dry-dusting with "Ceresan" or "Agrosan," using machines on the lines of the one previously described in this *Journal*. (T. A. Sellwood: Dry-dusting of Cereals, *N.Z. Journal of Agriculture*, December, 1935.)

During the 1935–36 season further field trials were carried out with these two materials on wheat, oats, and barley in the chief cropping-areas of the Dominion in collaboration with Mr. J. C. Neill, of the Mycological Laboratory. The results of detailed experiments conducted by the latter at Palmerston North have been published recently. (J. C. Neill: Experiments with two Organic Mercury Seed Dusts, *N.Z. Journal of Agriculture*, April, 1936.) The methods followed in the field trials were along the lines of those previously adopted—*i.e.*, one or more bags of seed were treated with "Agrosan" or "Ceresan" at 2 oz. per bushel, and these were sown by the farmer on a defined area. In three trials replicated plots were sown in order to determine any yield differences, although in two of these "Agrosan" was not used.

Results of Yield Trials.

1. *Trial on Oats at Winton Experimental Area.*—Date sown: 4th October, 1935. Date harvested: 1st February, 1936. Crop weighed on 13th February, 1936, for yield of chaff.

The yield of chaff from the formalin-treated seed was 39·6 cwt. per acre, whereas that from the "Ceresan-New"-treated seed was 42·5 cwt. per acre.

The difference of 2·9 cwt. in favour of "Ceresan" was not statistically significant. During growth no positive differences were observed, and both treatments were free from disease at harvest.

2. *Trial with Wheat on Farm of A. Craig, Greenfield.*—Date sown: 28th August, 1935. Crop harvested: February, 1936.

The plots were threshed separately and weighed by Mr. Craig, with the following results: Formalin-treated seed yielded 41·2 bushels per acre, while the "Ceresan-New"-treated seed yielded 50·4 bushels per acre.

The yields were not examined statistically, but the large difference of 9·2 bushels in favour of "Ceresan" is likely to be real, in view of the

consistent superiority of "Ceresan" as judged by observations before harvest. During growth the "Ceresan" plots appeared markedly superior in growth and vigour, and prior to harvest were at least 1 in. taller than the formalin plots.

3. *Trial with Wheat on Farm of J. G. Fiecken, Tai Tapu.*—Date sown: 29th August, 1935. Crop harvested: 12th February, 1936.

Germination counts were taken on the 4th October, 1935. The results were,—

Seed Treatment.	Germination Counts. Number of Plants per 10 ft. of Row.	Yield in Bushels per Acre.
Copper carbonate ..	81·3	38·4
"Ceresan"	87·0	39·6
"Agrosan"	85·9	40·1

Differences in yield were not statistically significant. The number of plants on both "Ceresan" and "Agrosan" is significantly greater than that on the copper-carbonate treatment.

Results of Observational Trials.

In the remainder of the trials observations were made during the growing-period, and these are summarized in the following table:—

Performance of "Ceresan" and "Agrosan" as compared with other Seed Treatments.

Seed Treatment with which Dusts were compared.	Number of Trials.	"Braird."			Crops.		Smut.	
		Better.	Equal.	Worse.	Better.	Equal.	Better.	No smut.
Oats—								
No treatment ..	5	2	3	..	1	4	1	4
Formalin ..	8	3	4	1	2	6	1	7
Bluestone ..	1	..	..	1	..	1	..	1
Wheat—								
No treatment ..	2	1	1	..	2	..	1	1
Formalin ..	1	1	..	..	..	1	..	1
Copper carbonate ..	3	2	1	..	1	2	..	3
Bluestone ..	5	4	1	..	3	2	..	5
Barley—								
Formalin ..	2	..	2	..	..	2	..	2

COMMENTS ON ABOVE TABLE.

The column headed "Braird" refers to the appearance of the crop at or within a few weeks of germination. Out of fourteen trials on oats the "Ceresan" and/or "Agrosan" gave earlier or thicker strike than the farmer's treatment in five trials, while in two experiments the reverse was recorded. On wheat the mercuric dusts were reported to give a better strike than the farmer's treatment in eight out of eleven trials.

Under the heading of "Crop," observations were made at about harvest, and where differences were recorded they were generally manifested in the crop being taller and thicker. In three crops of oats and six crops of wheat differences were in favour of "Ceresan" and/or "Agrosan."

Observations on both loose and covered smut of oats, covered smut of barley, and stinking smut of wheat are included in the column headed 'Smut." Plots treated with "Agrosan" or "Ceresan" were all completely free from smut, while in three of the control plots smut was reported as being present. In one trial on wheat the difference in disease and crop was extremely marked, and the yields from "Agrosan" and "Ceresan" plots were estimated to be at least 15 bushels per acre more than the yield of untreated areas alongside, which was considerably reduced by incidence of both rust and smut.

No differences in braird, crop, or incidence of smut were noted in two experiments on barley.

No attempt has been made to record the performance of "Agrosan" and "Ceresan" separately in the above table. In three trials, however, "Ceresan" was judged to be superior to "Agrosan" in thickness of germination, and in two of these this difference was apparent at a later stage of crop development, although "Agrosan" was nevertheless considered to be better than control. In one trial the "Agrosan" area germinated more quickly than the "Ceresan" one.

Summary.

Three yield trials and twenty-seven observational trials were carried out with organic mercury dusts—namely, "Agrosan" and "Ceresan"—on seed of wheat, oats, and barley. The results tend to support field trials previously conducted with "Ceresan," and also detailed experiments conducted with both materials by Neill in the present season, and which indicate that these materials are at least as effective in controlling smut as any of the older methods. There is often an added advantage in that the mercury dusts frequently assist field germination, and this is reflected in an improved yield.

In one of the yield experiments (which did not include "Agrosan") "Ceresan" gave an increase of 9·2 bushels per acre. In the two other yield trials no statistically significant differences in yield were obtained, although, in one of these, significant increases in field germination were obtained from both "Ceresan" and "Agrosan."

There are indications that farmers, particularly in the South Island, are rapidly changing over to these dusts in preference to wet "pickles," and even copper carbonate is being superseded.

The field work of the experiments reported above was carried out by officers of the Fields Division in the various cereal-growing districts throughout the Dominion.

The thanks of the Department are extended to those farmers who co-operated in carrying out the trials, and also to Messrs. Fassett and Johnson, Ltd., and Messrs. Campbell Bros., who donated the "Ceresan" and "Agrosan" respectively.

—J. W. Woodcock, Crop Experimentalist.

SEASONAL NOTES.

THE FARM.

Pasture Establishment.

UNDER a wide range of conditions pasture seed-mixtures often may be suitably sown in September. To obtain the fullest possible assurance of success, several matters require careful attention. Failures partial or complete in the establishment of pasture arise commonly because of—

(1) *Sowing when it is too cold—i.e.*, too early in the spring or too late in the autumn—sowing at an unsuitable date is a fruitful cause of poor results in clover establishment, and, in general, pastures poor in clovers are poor pastures. Certainly at times volunteer clovers repair to some extent the weakness due to the failure of the seed which was sown by the farmer, but in any case there is usually a delay in the functioning of the volunteer clover, and, further, and probably of greater importance, the volunteer clover may be of a strain much inferior to that selected for sowing because of its known inherent valuable characters. This is particularly the case when certified clover-seed is included in the mixture.

(2) *Sowing on poorly prepared seed-bed*, which may occur readily in the spring, especially should the cultivation be carried out when the soil is too wet for good results from tillage. Coarseness and lack of consolidation in the soil are the two common major weaknesses in seed-beds for pastures. When the soil is in what is commonly called a "lumpy" condition as distinct from one in which the soil has been "well worked down," it is clearly impracticable to carry out any process of covering the seed which does not necessarily result in a portion of the seed being covered too deeply. Some of the valuable kinds of pasture-seed are so fine that the depth of covering may not be particularly great and yet be too great, having regard to the small size of the seeds. The value of consolidation in seed-beds for pastures often is exemplified by the superiority of the "strikes" obtained where additional consolidation has taken place through the passage of stock or machinery.

Sowing on poor seed-beds frequently results in poor "strikes" of clovers, and the undesirable consequences of poverty of clovers have at times been so remarkable that farmers have sought for official information about what was considered to be an attack of disease, but which actually was merely poor thrift in the sward arising primarily from the absence of clovers.

(3) *The use of inferior seed.*—Seed may be poor because of its low germination capacity or its unsatisfactory purity; seed may be good in respect to purity and germination capacity and yet remarkably poor because it lacks inherited strain-characters desirable for the purpose in view.

Importance of Strain Characteristics.

Both the outstanding importance of the use of suitable strains of pasture-plants and the marked superiority of certain strains over other strains of the same species that are in commerce have become so very widely known during recent years that there now is much less need to direct attention to the economic importance of strain differences within the one species of pasture-plant. But although many farmers insist on obtaining seeds of known superior strain-characters, the fact remains that much seed of inferior strain is produced annually, and the bulk of it is used in New Zealand, while some of the seed of good strain is being exported. The position would be ludicrous if it were not so lamentable, and

from it one cannot form a particularly complimentary opinion of those farmers who use inferior strains of pasture-plants, when their real need is for the superior strains, and when they are not compelled to resort to the inferior strains the use of which is not economic.

The practical application of our present knowledge of strain differences in species of pasture-plants is to use certified seed when this is available. The species of major importance are perennial rye-grass and white clover; red clover and cocksfoot are species of considerable importance, and Italian rye-grass, which has come under certification only in relatively recent times, is of value in the sowing of temporary pastures. In view of the usual greater cost of lines of certified seed, it should be remembered that the use of inferior strains in the establishment of permanent pastures is almost certain to lead to a long period of avoidable depressed production of the pasture or to its unnecessarily early breaking-up and resowing. When this is borne in mind the use of the more expensive superior strains of seed will be seen in its true status as real economy rather than as extravagance. In practice the different classes of certified seed of any of the species is of some importance: full particulars about this may be obtained from local officers of the Fields Division.

Seed-mixtures.

The pasture seed-mixtures used by different farmers for the same set of conditions and the same ultimate purpose—*i.e.*, the establishment of a pasture to remain at the highest possible production for as long as possible—often vary a great deal in their constitution. Obviously two seed-mixtures which vary greatly in the content of species that are of basic importance are not likely to be equally suitable. It would be far from true to say that any definite finality has been reached in regard to the optimum composition of pasture seed-mixtures for conditions for which it commonly is necessary to prescribe. Nevertheless, a considerable amount of knowledge has been gained of mixtures which do or do not give good results (although maybe not the best results possible) under certain conditions. On the basis of this knowledge certain seed-mixtures which may almost be called "standard" mixtures have been drawn up. These are mixtures which have been used extensively in recent years with relatively good results. The composition of the principal mixtures of this type is given in these notes in the February, 1936, *Journal*, and further information about these mixtures and other mixtures which may be more valuable for specific conditions is obtainable from local officers of the Fields Division.

As a rule permanent pastures are established most successfully when sown without companion crops, which somewhat misleadingly at times are called "nurse" crops: if the companion crops are heavy vigorous ones they are more likely to weaken the young pastures by over-shading rather than to assist them. When companion crops are deemed advisable their injurious competition may be lessened by the use of lighter seedings, and when the companion crops are cereals the period of competition should usually be shortened by harvesting the cereal for silage or chaff.

General Work with Pastures.

Often with advantage the feeding-out of hay, silage, and roots may be concentrated on fields on which ravages of the grass-grub are in evidence. The trampling and the additional fertility induced by the feeding-out seem of value in assisting injured plants on which there are vestiges of roots to recover more readily. Further, the feeding-out of hay, especially that in which there are viable seeds of valuable species, may result in a certain amount of useful surface-sowing. When the bulk of the valuable species in a pasture has already been destroyed, it is advisable to put the land under the plough, to be followed eventually by resowing. A pasture or

cereal cannot safely be sown immediately after a pasture or cereal which was attacked by the grass-grub—a sufficient number of the grubs is likely to be carried over, despite cultivation, to bring about serious reinfestation of the ground.

Grass-harrowing is likely to be much needed on those paddocks on dairy-farms on which stock have been held for winter-feeding. In particular, fields from which it is planned to harvest hay or silage during the coming summer should be harrowed thoroughly just before closing up.

Profitable results as a rule follow the application of phosphates to a pasture at the time of sowing or shortly afterwards. Such top-dressing tends to provide the seedlings with extra vigour, and this aids them in passing through the critical young stage.

Fields for Hay and Silage.

Fields intended for haymaking or ensilage should be closed up as soon as they can be spared from grazing. Early closing-up is valuable in that it favours the possibility of early mowing, which in its turn gives greater probability of a good aftermath which generally is very useful in the latter part of the summer. A top-dressing with superphosphate at closing-time is often advisable on fields for hay and silage, especially those not recently top-dressed.

September is often also a suitable time to close up lucerne areas: it assists in securing a comparatively early cut for ensilage, followed by a second cut before or about New Year. The general result of early closing of lucerne and the saving of the first cut as silage is an extra cut from the lucerne annually.

Seasonal Tillage.

A common cause of relatively poor crop-yields is the sowing of seed on land that has not received sufficient cultivation, and on many farms the only way to rectify this weakness is to miss no opportunity at this season of pushing on with tillage. Hence on most farms an extremely busy period is at hand, provided weather conditions permit of field work being carried out. But it should not be forgotten that more harm than good may result from working wet land: sandy soils may be worked with safety practically at any time, but great care must be taken not to work clayish soils while they are too wet. Sometimes it is possible to keep the implements at work by diverting them to old grassland when it is impossible to cultivate, without danger of injury, land which has been under cultivation for some time.

Provision of Special Feed.

One of the most important purposes of spring field work should be provision of adequate reserves of suitable feed for use during those periods when the feed directly available from pastures is less than the current requirements of the stock that any particular farm is able to support efficiently if its feed-supply is properly adjusted. The attaining of efficiency consists not simply in providing special reserves of feed adequate for the stock being carried, but adequate for the stock that can be carried if the feed-supply throughout the year is properly adjusted and utilized. Some farmers manage to carry on by providing only relatively small reserves of special feed and by tending to adjust stocking on the basis of minimum carrying-capacity. Such farmers do not exploit fully the productive capacity of their farms, and regularly are faced with surplus supplies of feed, especially in the summer, for which it is difficult to find economic use. Some sheep-farmers use the surplus feed by grazing cattle from which they receive little or no net return for the considerable amount of feed consumed. It may be granted that in some instances the use of cattle in this manner is unavoidable, but it does seem likely that cattle are at times used in this manner when such use could be avoided, and when greater net returns

could be obtained from the farm as a whole had the summer supply of feed been balanced by greater supplies at other periods made available by the creating of special reserves of feed. Enough has been said to indicate a farm-management problem of considerable importance. Two main questions arise. Firstly, should the seasonal supply of feed be adjusted so as to give the most effective possible use of the whole supply of feed produced on the farm, or, secondly, should the stocking of the farm be adjusted so as to avoid the need of much provision of special feed and so as to result in a portion of the feed produced being consumed with negligible direct economic return? The position seems to be this: no answers capable of general application can be given to the problem because much depends upon the circumstances in individual cases. To accept an affirmative answer to the second question is to adopt the easier course of action. Probably the easier course is not the best economic course in all of the many instances in which it is adopted. This matter may opportunely be raised at this stage because cultivation for some of the crops most important in the provision of special feed should receive attention now at every suitable opportunity. For use in the winter, mangels, carrots, chou moellier, swedes, and turnips are all suitable. Except in the more severe and southern districts mangels give particularly good returns when they receive the benefit of high fertility and good cultivation. They are extremely reliable, being practically free from attacks of any serious disease or pest; they can withstand dry periods relatively well, and when they receive suitable treatment their total yield of nutriment per acre is very high. Because of these facts they should be grown much more extensively than they are grown. When the farming is somewhat extensive, with the result that the good treatment desirable for mangels cannot be given readily, swedes and turnips often may suitably replace them. Chou moellier rightly has increased in popularity in recent times for use in good ground. Its requirements are similar to those of the cabbage, and hence land intended for it should be naturally rich or should be enriched by the free use of manures. Chou moellier is very suitable when club-root infection is known or expected to be in the soil: chou moellier though not completely immune is very resistant to attacks of this serious disease. Chou moellier is also of particular value on ground that usually is so wet at the time of feeding-off as to make swedes not altogether suitable. Carrots are suited by free fertile soils, on which, as many Taranaki crops have demonstrated, really good yields can be obtained. Often it is advisable to grow more than one of these crops, so as to obtain a more prolonged supply of feed than a single crop would provide. For instance, chou moellier and carrots may serve usefully for feeding before mangels have become fully mature. All the crops under consideration benefit from a good clean seed-bed and a cultivation subsequent to ploughing usually is valuable in providing a soil of good tilth.

Lucerne.

For the provision of special feed lucerne, which is of particular value, calls for consideration at this period. The outstanding merit of lucerne as a forage crop arises from a combination of characters including high yield, high nutritive value, reliability during critical seasons, low cost of production, and capacity to improve soils. An acre of thriving lucerne readily may yield annually 25 tons of green forage equivalent to a yield of 6½ to 7 tons of hay. Green lucerne when utilized before it has become woody is rich and highly digestible, while well-saved lucerne hay, because of its high nutritive value, may be used suitably to supplement feeds which are somewhat inferior. Because of its deep root-system it is well able to withstand drought, and so is reliable during difficult summers in which many other crops are prone to fail. Deep, fertile, open, well-drained soils are best for lucerne. However, judging from considerable field experience in New Zealand, lucerne can be grown successfully on a wide range of soils providing

their drainage is good. Good surface drainage and good underdrainage are both necessary for success with lucerne over a series of years. Lucerne is not well fitted to battle against weeds in its early life. Hence it is often advisable to sow lucerne on land which has been in old pasture and which has been ploughed once only: this normally gives a seed-bed less infested with weed-seeds sufficiently close to the surface to germinate than does land which recently has been under the plough for some time. Perennial twitchy weeds are especially objectionable in lucerne areas.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Seasonal Spraying.

THE early sprays prior to the blossoming period are of vital importance for the control of fungoid diseases. Spraying pip-fruit trees at green-tip and stone-fruit trees at bud-movement is generally recognized as the correct procedure. This initial application is referred to as the "foundation" spray, and, under normal seasonal conditions, if omitted from the spray programme, makes it impossible to secure a clean crop. Orchardists generally are fully aware that fungoid diseases cannot be cured, but can be prevented, and, therefore, appreciate the necessity for applying sprays at the above periods as a cover on the trees before the spores of fungous diseases become established on the young fruits and foliage.

All appliances should be in good working-order, so that no time is lost when spraying actually commences. This means that the spraying-machine and appliances should be overhauled, and, where a stationary outfit has been installed, it is also necessary to see that the pipe-line and taps are all in good working-order. The hose and nozzles should also be checked over. In many instances it has meant to growers the difference between profit and loss to find a burst hose or choked nozzle just when the spraying has been about to commence. Many an orchardist has had a dirty crop of fruit owing to the fact that he has taken the risk of his outfit being in good order, only to find that when he was ready to commence spraying the whole of the outfit needed overhauling, and by the time the machine, hose, &c., had been put in order rain had set in and disease had become established before the necessary spray could be applied. It should be remembered that the wet weather which holds up the application of the sprays enables disease to become established.

It is necessary to be thorough when applying sprays to fruit-trees. Every portion of the surface of the tree from the highest to the lowest twig must be thoroughly wetted. It is false economy to rush through the job because it is unpleasant work. Some growers are inclined to endeavour to make 100 gallons cover the area for which 200 gallons of spray are required. It is better to have too much than insufficient coverage of spray material.

An application of Bordeaux mixture (5–4–50) at green-tip stage is recommended for the control of black-spot on apples and pears. To this may be added winter spraying oil (1–25), which will be found an effective control for red-mite and scale insects. Three weeks later lime sulphur (polysulphide content 15 per cent.) (1–80) should be applied. If powdery mildew was prevalent on the trees during the previous season, lime sulphur (1–25) can be substituted for the Bordeaux at green-tip, to be followed by lime sulphur (1–50) ten days later, and after a further interval of ten days lime sulphur (1–80) should be applied.

For the control of peach leaf-curl, shot-hole fungus, bladder-plum, and brown-rot, &c., on stone-fruit trees, a thorough application of Bordeaux mixture (5–4–50) when the buds begin to swell is recommended. This should be followed by lime sulphur (1–80) at the pink stage. For the successful control of peach leaf-curl it is important that this application should be made before the most advanced leaf-buds reach the green-tip stage. The terminals of all lateral growth should be thoroughly covered with spray.

Cultivation.

Good cultivation of the orchard is necessary, and if the annual ploughing has not already been done it is advisable to attend to it as soon as the soil is in a fit condition.

Where late autumn ploughing was done, the spring ploughing may be deferred for a short time, to enable the cover crop or grass and weeds to rot, otherwise if the second ploughing is commenced too soon the cover crop or other herbage will be turned to the surface and commence growing again. Cultivation around the base of the trees is too often neglected, and should be given greater attention. The soil around the trunk and fibrous roots will be benefited by this aeration. Undisturbed ground at the base of trees not only is a harbour for diseases and pests, but needs cultivation to assist the growth of beneficial bacteria in the soil. If this work is completed at an early date, it will not be a difficult matter to keep a free surface on the soil throughout the remainder of the season.

Manuring and Liming.

Growers are now beginning to realize that it is impossible to obtain good results every season without applying organic matter and fertilizers to the soil. It makes no difference whether the soil is rich or poor (with the exception of the matter of time); sooner or later plant-food that has been used up by producing fruit must be replaced. As soon as possible after these notes appear manure should be applied, to allow the spring rains to carry it down into the soil.

It is difficult to state definitely the exact amount of fertilizer which is required in individual orchards, but the following may be taken as a basis to work on in applying manures to bearing trees: Superphosphate, 2 lb.; sulphate of potash, 2 lb.; and sulphate of ammonia 1½ lb. per tree. Of course, this should be varied somewhat according to the growth and crop-yield of the tree. For instance, if a tree is making vigorous growth and not producing much fruit, the potash may be increased to 3 lb. and the ammonia decreased to 1 lb. per tree. Or, on the other hand, if a tree is stunted in growth and producing a large crop of small inferior fruit, the potash may be decreased to 1 lb. and the ammonia increased to 3 lb. or more per tree.

Liming of the land is also beneficial, and should not be neglected. The application of 1 ton of carbonate of lime per acre every two or three years should tend not only to improve the physical condition of the soil, but to make more plant-food available. In addition to this, it will be found to assist the growth of the beneficial bacteria which enrich the soil, and without which trees cannot produce satisfactory growth and crops.

—B. G. Goodwin, Orchard Instructor, Christchurch.

Citrus Notes.

The time for the heaviest pickings of the year is now at hand. In addition to lemons, New Zealand grapefruit (Poorman orange) and sweet oranges have to be dealt with, and these latter now are reaching a more mature condition for marketing for dessert purposes. There is evidence that New Zealand grapefruit is becoming increasingly popular

with the consuming public as a breakfast food. It is important, therefore, that growers make sure that fruit which is marketed for dessert purposes is in suitable condition (tree-ripened) for this purpose, otherwise sales may receive a setback. As regards picking, the points mentioned in the notes for June and July are of such importance that one would suggest that they be re-read at the present time. It is impossible for the citrus-grower to achieve success by any quick, easy method: on the contrary, as field observations verify, those who are making most progress to-day are the growers who are attending very carefully to all the numerous small details which in the aggregate give worth-while results.

During harvesting a careful analysis of the rejects at picking-time will enable one to detect weaknesses in the programme of work which has been followed, and these observations should be committed to paper so that they may be referred to during the coming year. For example, if a certain block of oranges is showing a large percentage of silvery russet due to thrips injury, with a consequent degrading of the fruit, a note for future guidance is useful. In addition to this, where only odd trees are infected, they should be marked by attaching a piece of rag or other material in a conspicuous place, so that these trees may receive the necessary attention at spraying-time. Where during picking operations it is found that much of the fruit on a particular tree has failed to attain satisfactory size, consideration should be given to the condition of the tree, and a decision arrived at as to whether special attention by way of renovation or manuring is required. These trees should also be marked distinctively, a good practice being to have different coloured tags to denote different requirements.

New Plantings.—New orchards or extensions to existing ones are still being planned in some districts, and, although it is somewhat early for planting, it is necessary that several details be considered now. The matter of varieties must be decided upon, and, if it has not been done already, the trees should be ordered without delay from a reliable nurseryman. Where it is possible, it is advisable for the grower to visit the nursery and inspect the trees offering before purchasing, as it is important for the success of the venture that healthy, good-type, vigorous stock be purchased. Price should be secondary to quality, as a pound or two extra spent now in obtaining thrifty trees should be worth much more in returns later.

The matter of the stock on which the trees are worked is of importance, although, unfortunately, there is not a great deal of data available on this point for New Zealand conditions. Many growers are unaware of the stock on which their trees are worked, and a point for new planters is that they should find out this before buying the trees. The choice of stock will be limited at present to that which the nurserymen have used for the raising of the trees. Those recommended just now are sweet orange (*Citrus sinensis*) or rough lemon (citronelle). Trees worked on the trifoliate orange (*Poncirus trifoliata*) undoubtedly produce fruit of excellent quality, but in most instances they are so dwarfed in size that the quality of the fruit does not compensate for the lack of quantity. This stock is particularly unsatisfactory on light sandy soils. However, as it is not feasible to deal with the requirements of the various districts in these general notes in reference to stocks and the varieties to plant, it is advisable for growers to consult the local Orchard Instructor for this particular advice.

Owing to the probability of over-production, further general plantings of lemons are not recommended, unless the demand can be increased very considerably in the future. Our present knowledge indicates that further plantings of sweet oranges and New Zealand grapefruit are warranted. The latter does well in all of the citrus districts, and should be included in any new plantings. The sweet orange, however, should be confined to the warmer localities of the northern districts of the Dominion. The varieties

from which a selection may be made are—Hamlin's Early, Washington Navel, Jaffa, Best's Seedless (improved strain), St. Michael, Pineapple, Ruby Blood, and Late Valencia.

Some growers have planted out considerable numbers of trees of Marsh's Seedless (American grapefruit), but a word of warning should be sounded against indiscriminate planting of this variety, as reports on existing trees in New Zealand, even on those up to ten years old, show that the fruit produced is thick-skinned, pithy, and lacking in juice. Until further evidence as to its suitability is forthcoming, planting of this variety should be confined to small experimental lines.

The preparation of the land for new orchards should have been commenced long ago. It is essential that it be in good mellow condition before planting. If the area is infested with couch-grass, the trees should not be planted out until the ground is cleaned up. Similarly with regard to shelter, on no account should citrus trees be planted until this has been provided. If it is desired to take delivery of trees this year so that twelve months' growth may not be lost while the ground is being cleaned up, they may be planted in nursery rows about 3 ft. apart and 2 ft. between trees. The small area occupied by the nursery must be well cleaned up and cultivated by hand hoe and the trees sheltered by scrim or brushwood where necessary. The following year, if the land is ready, the holes should be prepared, the trees lifted carefully with the roots intact, placed on a sledge a few at a time, transported to their new positions, and planted without undue delay in their permanent positions. Under this treatment they should commence growth without noticeable setback.

Manuring.—It is now time to consider the matter of fertilizers for the grove. If possible, organic matter, such as cover crops, farmyard, sheep, fowl, and well-conditioned fish manure, &c., should be turned in annually. As a source of nitrogen, sulphate of ammonia is the cheapest concentrated form, and it has been found that of all the fertilizing elements nitrogen is one of the most important. If sulphate of ammonia is used, carbonate of lime at the rate of one and a half times the amount of the former should be applied as well, to correct the acidity created by the ammonia. Nitrate of soda may be substituted for sulphate of ammonia. Blood and bone and well-matured fish manure of good quality are approved citrus fertilizers, while superphosphate and potash should also be applied. Where blood and bone is used a dressing of up to 20 lb. per mature tree should be applied in the month of August; or, if artificial fertilizers are used, 6 lb. of superphosphate and sulphate of ammonia plus 3 lb. of potash, either sulphate or muriate, and 9 lb. of carbonate of lime may be put on broadcast over the ground between the trees. Young trees should receive a dressing applied about the tree in a small circular band, which is gradually increased in size each year, until the whole area is covered. The quantity in the case of trees just planted should be small, say, 1 lb. of the above mixture, progressively working up to the full quantity. Manures, particularly those of the farmyard kind, should not be placed in contact with the trunk of citrus trees, owing to their liability to cause diseases of the bark. It is a good plan to vary the type of fertilizer used from year to year, provided that the main requirements mentioned above—viz., organic matter and nitrogen—are not overlooked.

Although cultivation of existing groves and the planting of citrus trees should be dealt with in the spring, due consideration should be given to the climatic conditions which usually prevail in the particular district which concerns the grower; and, where cold snaps are likely to occur well into September, it will be as well not to accelerate these operations, especially in those districts where the spring rainfall is adequate. In the following notes, which appear on 20th of September, these matters will be dealt with more fully in them.

—*A. R. Grainger, Orchard Instructor, Tauranga.*

POULTRY-KEEPING.

Egg-export.

DURING the spring of 1923 three shipments of eggs were exported from New Zealand to London. These were the first shipments of any size from this country, and they were made more or less as an experiment to ascertain whether our fresh eggs could be successfully landed in London and sold at a profitable price. As is well known, the eggs arrived in good condition and created a very favourable impression on that market, and practically every spring since eggs have been exported.

During last season some 11,915 cases (357,350 dozen) of eggs were shipped to the United Kingdom, the provincial totals being—Auckland, 78,300 dozen; Wellington, 5,730 dozen; Canterbury, 190,980 dozen; and Otago, 82,440 dozen.

Although this number represents only about 3 per cent. of the total number of eggs marketed in this Dominion, it is essential for the welfare of the industry that every effort be made to dispose of all our spring surplus, and also maintain the good reputation that New Zealand eggs have already made on the London markets.

Preparations are now being made for this season's export, and although individual poultry-keepers may consider that because their actual output is small, and they cannot export, the export business is no concern of theirs. This is quite a mistake: the export vitally concerns all producers as, although individually their output may not be large, the whole production goes to create the surplus which makes export necessary, and thus export is as much the concern of the small producer as the large, and all eggs should be forwarded in the most attractive manner.

The most desirable qualities in a good marketable egg are freshness, cleanliness, flavour, and size. As the eggs arrive at the export floor, they are unpacked on to trays and graded to size. Cracked, dirty, or mis-shaped eggs, or those too small, are rejected. All eggs are then individually tested before a strong light for freshness. The air-cell must not be more than $\frac{3}{16}$ in. in depth, contents must be stationary, white firm and clear, yolk dimly visible through shell, of good colour, and no process of putrefaction and no development of the ovum must have taken place.

Freshness.—It is doubtful if there is any other product where value depends more directly on freshness than an egg. When first laid an egg is practically full of liquid, but, as the shell is porous, the liquid gradually evaporates, leaving an air-space. Thus the older the egg the larger the air-cell becomes. Some egg-shells are more porous than others, and the more porous shells allow a more rapid evaporation to take place; nevertheless, the size of the air-cell is a good general guide as to the age of the egg, and if the air-cell is more than $\frac{3}{16}$ in. in depth such eggs are rejected for export.

This drying-down process is naturally more rapid during hot dry weather, or if eggs while being held for market are stored in warm or hot places. The keeping-quality of all eggs is affected if exposed to a temperature above 90 degrees. Fertile eggs deteriorate if exposed to a temperature of 70 degrees. Eggs actually are fresher after three weeks' storage in a cool, dry place than after a week in a temperature of 70 degrees. For these reasons, when eggs are being held before marketing, it is advisable to keep them in a cool, dry place.

Musty or Tainted Eggs.—Flavour is a very important factor in an egg, and one of the worst eggs a baker has to contend with is the musty egg, owing to the fact that one such egg is likely to destroy the

flavour of a whole cake mixture. Musty eggs, which are difficult to detect, may be caused by the feeding of musty grain or other foods. At times hens that have free access to pigsties or manure-heaps are apt to pick up unpleasantly flavoured food, and that taint may at times be transmitted to the egg. Again, musty eggs are often due to being laid on damp straw or nests, or being packed in damp, musty fillers; and also if allowed to stand in damp, musty fillers for forty-eight hours their flavour is likely to be affected.

Some hens lay an egg that may taste stale, but mustiness and undesirable flavours in eggs can usually be avoided by care and attention to details. Where good sound food is fed, plenty of good, clean, dry nesting-material provided, and if care is taken to see that eggs are collected regularly, stored in a dry cool place free from unpleasant odours, and sent to market in clean, dry cases and fillers, there should be little trouble from musty eggs.

Soiled Eggs.—Only absolutely clean eggs can be passed for export, and it is safe to say that more eggs have had to be rejected on account of the shells being more or less soiled than from any other cause. It has often been very disappointing to those at the grading-store to have to reject otherwise fine eggs on that account.

If clean nests were provided, say one to each four or five birds, and eggs were collected twice a day, especially in wet weather, much of this trouble would be avoided. In this connection, it is a good idea to have a tin, box, or spare nest covered up, and whenever the fowlhouse is visited to put the eggs laid into that receptacle to hold until the usual collections are made, thereby saving many eggs from becoming soiled because of hens walking over them. It is preferable that eggs for export should not be washed. However, when eggs become so soiled that they need washing, it is better to wash them in warm water as soon as they have been collected and before the animal heat leaves the eggs, as they are much less trouble to clean then. Washed eggs should never be placed in cardboard fillers until they are thoroughly dry. Badly stained eggs may be cleaned for table use by soaking them in a solution of 3 parts of water to 1 of vinegar.

Eggs having watery whites and tremulous air-cells have to be rejected, as such eggs dry down more rapidly. A great deal of investigational work has been carried out by workers all over the world, and by this Department, to ascertain the definite cause or causes of this defect. Authorities have mentioned several likely contributing causes, such as the physical condition of the hen, lack of or too much green food, insufficient animal food, or allowing eggs to get into a sweated condition. However, tests have shown that the method of packing has a big influence on the internal condition of many eggs, and, if packed with the large end down, this defect is likely to be produced. Better results are obtained when holding eggs for market, and especially when packing for transport to market, by taking care that all eggs are packed with the small end down.

Carriers.—Each season quite a number of more or less broken crates arrive at the grading-stores. Not only have many eggs been broken on this account, but other eggs have had to be rejected owing to their being soiled with the contents of the broken eggs. Where wire carriers are used, it is advisable to place strips of paper between the wires in order to save eggs from being badly marked by twisting around in the wires during transit.

Shell-texture.—The quality of the shell is another important factor in a good marketable egg. A strong smooth shell is most desired. Thin or rough, porous shells allow too much evaporation of the egg liquid, with the result that they dry down rapidly and are soon classed as second grade.

Again, thin-shelled eggs are more liable to get cracked or broken. Each season a large number of eggs has to be rejected on this account. A record kept of an average lot of 11,880 eggs showed that 514 eggs had to be rejected because the shells were cracked. By taking care when collecting eggs, and especially when packing them into fillers for market, a good deal of this loss could be avoided.

Size.—Shape and shell-quality can be improved by a careful selection of eggs for hatching purposes. Only 2 oz. eggs of good shape, texture, and colour should be set. The stock should be supplied with plenty of oyster-shell grit, and, if the shell-texture is generally poor, the addition of 1 per cent. of oyster-shell dust to the mash and a little burnt, broken bone for the birds to pick at should help.

The following is an analysis of two average good lots of eggs sent to be graded for export :—

		Per Cent.
Number recorded	54,420	
Packed for export	46,919, or	86.2
Rejected for being cracked	3,489, or	6.4
Rejected for being soiled	1,783, or	3.27
Large air-cells or watery whites	1,777, or	3.26
For bad shape, and too small	387, or	0.71
For blood spots	65, or	0.10

Owing to the enormous competition on the London market, and owing to the fact that New Zealand eggs have to travel a long distance before reaching the British consumer, every care must be taken to see that grade and quality are kept up. These defects have been pointed out in order to assist producers to reduce the great loss caused each year by thousands of eggs being spoiled by causes which, with a little care, could be prevented.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Breeding.

Normally at this season of the year there are large patches of brood in the hives. A further examination may be carried out where the beekeeper was in doubt in the preceding month as to the hive being queenless or not. The absence of brood at this season denotes that the queen is poor or that the hive is queenless. In either case it is advisable to unite with another hive. This should be done immediately, as a queenless hive stands in great danger of being robbed by other bees in the apiary. A ready method of uniting is by placing the weak colony over a strong one on the stand of the latter, with a sheet of newspaper between the two hive-bodies. The colonies may be examined after a couple of days to see if things are going well, and if the paper is not bitten through it should be torn in several places. In another day or two the united colonies will be working peaceably. In the case of the weaker colony it is wise to kill the queen before uniting.

At this examination the beekeeper must keep a strict watch for symptoms of disease. If foul-brood is discovered in a mild form the colony should be marked for treatment later in the season. Should the colony be badly affected, however, it is advisable to sulphur the bees and destroy the combs. Care should be taken to remove the hive to a place of safety until it can be properly cleansed.

Overhauling the Hives.

In August a great deal of the preliminary seasonal work of the apiary may be done. Each hive should receive a good coat of paint. This will help to preserve the timber, besides giving the hives a neat appearance.

The bottom-boards should be scraped clean. During the winter months there is usually an accumulation of cappings, pollen, and dead bees, and this, if left, becomes a harbour for woodlice, which are very objectionable. A simple plan is to provide a spare bottom-board. Lift the hive on to the spare one, scrape the old board, and replace the hive. Remove all top boxes, and make the bees snug and warm for brood-rearing. Clean all weeds and long grass from round the hive. Long grass keeps the hives and bottom-boards damp, and acts as a harbour for insects.

Cleansing Hives and Frames.

The beekeeper should not fail to cleanse all hives and frames that have been in contact with diseased colonies. This work may be undertaken now, and the hives and frames prepared for future use. Where there is only a small number of frames to be cleansed it is hardly worth while to attempt to save them. However, if much material has to be treated the saving effected will more than pay the beekeeper for his time and labour. There are several methods for treating hives and material, but perhaps the simplest and most effective is by the use of boiling water and caustic soda. Many beekeepers recommend the use of a painter's blow-lamp, but this is not always handy, besides which the charring of the hives indicates for all time that they once contained diseased bees.

The most suitable vessel for cleansing frames is an ordinary washing-boiler. To every 8 gallons of water add 1 lb. of caustic soda, and allow to boil. The frames may be tied in bundles of six and immersed in the liquid. The caustic soda attacks the propolis and wax, and this immediately floats on top of the water. Three to five minutes' immersion serves to cleanse each bundle of frames. Skim the refuse from the top of the water frequently, and as the solution weakens add more soda. Stack the frames in supers, and place in the sun to dry. The hive-bodies and bottom-boards may be cleansed by means of a swab. Immerse the swab in the boiling water and carefully wash the inside of the hives. Care must be taken when using caustic soda, as it is liable to burn the hands.

Robbing.

A strict watch should be kept for robbing. This is most likely to occur when feeding has to be undertaken, and once started it is about the hardest thing to cure. Feed only in the evening, so that the excitement created by the supply of warm syrup will have died down before morning. Keep the entrances to all hives contracted, and see that there are no cracks through which a robber can possibly enter. Perhaps the main cause of robbing is the presence in the apiary of queenless or weak colonies. If the bees once discover a queenless hive there will be no peace until the source of the trouble is removed. The inmates of such a hive do not defend their stores as do bees in a normal condition, and unless the colony is united with another it tends to demoralize the rest of the apiary, until none but strong colonies are safe from the depredations of the robbers.

Where a weak colony is in danger of being attacked, and where the beekeeper is satisfied that it is worth saving—that is, when he considers the queen good enough to build up a strong colony by the time the main honey-flow sets in—his best plan is to pile wet grass on the alighting-board and well up above the entrance, keeping the grass wet for a day or two, and painting any cracks in the hive with kerosene or carbolic solution. This treatment soon restores peace in the bee-yard. However, the best thing to do with the weak colonies is to unite them without delay with stronger hives. As in the case of most other troubles, however, prevention is the best thing when dealing with robbers. Do not spill any syrup near the hive, do not leave any combs lying about, and do not have any weak colonies, and you will not be troubled with robbing.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Lettuce Crops.

A NATIVE of Central Asia, the lettuce (*Lactuca sativa*) has been a popular salad crop from the dawn of history. It is in continuous demand at the present time, and possesses, among others, narcotic, anodyne, and sedative properties which are of value. It is generally used in a raw state for salads or garnishing; but, when plentiful, it is excellent as a cooked vegetable.

Including the dwarf cabbage and tall cos lettuces, the red and the green leaved, black-seeded and white-seeded, there are about a hundred varieties in cultivation, and of these there are many strains. The cos is a fine-flavoured lettuce, but the general demand is for a crisp, green cabbage lettuce. The most popular variety of this class is known as Webb's Wonderful, otherwise as New York, Hercules, or Neapolitan, although the latter is often a strain of a rather heavier type. This variety is being grown here under glass and outside at all seasons, and for summer and autumn cropping is unlikely to be displaced; but for winter and spring cropping here outside, or winter cropping under glass, there are in some instances more suitable varieties, especially for the cooler districts.

An effort has been made by Brian, of the Long Ashton Research Station, and others to classify the embarrassing number of lettuce varieties and their synonyms. It is work which is of great assistance to one who desires to make an intelligent selection. Brian has classified a number of leading varieties according to five of their main characteristics, but that characteristic which is most consistent is the cultural use of the variety. The list can almost entirely be divided into varieties suitable for growing under glass—forcing; varieties suitable for growing outside during the winter—winter lettuce; and summer lettuce. There are a few general-purpose varieties, chief among which are All-the-year-round, mainly sown in autumn or early spring outside or under glass in an unheated house; and Trocadero, otherwise known as Big Boston, with red-edged leaves, which is grown in winter and spring, to which is closely related the green variety Market Favourite (Unrivalled), which is another variety grown outside at all seasons in cool climates.

For a winter crop under glass the varieties Cheshunt Early Giant, Golden Ball, Feltham King, and All-the-year-round are some of the most satisfactory.

For a winter crop outside a trial of seventy-six varieties was made at Wisley, England, by the Royal Horticultural Society in the year 1923, which practically confirmed the results of a similar trial held five years previously. The seeds were sown on 5th September (5th March, New Zealand), and transplanted on 29th September, "on ground in an open situation which had had a previous crop of broad beans. . . . a few plants died, and their places were filled on 31st October, after which no planting was done." A committee examined the growing crops on several occasions, and the following awards were made:—

(1) Winter Giant (Veitch); Stanstead Park (Nutting); Brittany Winter White (Barr); White Madeira (Barr).
(2) Hammersmith Hardy Green (Cullen; Watkins and Simpson); Hardy Hammersmith (Dobbie); All-the-year-round (Simpson; Watkins and Simpson; Barr; Dickson; Toogood; Dobbie).
(3) Hercules (Dobbie); Grand Admiral (Veitch); Winter Brown (Barr); Schofield's Hardy Winter (Barr); Reliance (Barr; Watkins and Simpson); Early French Frame (Watkins and Simpson).

Of those receiving the highest award, Winter Giant and Stanstead Park are comparatively large with medium green leaves more or less tinted red. Brittany Winter White resembles Stanstead Park, but the leaves are a

paler green and not tinted. White Madeira is a large compact plant with firm head of good quality, tender—"a little-known but excellent hardy variety."

In the next class Hammersmith Hardy Green and Hardy Hammersmith are medium size, medium green colour without red tint (similar varieties are Hardy Winter Green, Immense Winter, Lee's Immense, Yates's Winter, and Hammersmith). All-the-year-round is rather large—medium green puckered leaves forms a fine heart of good flavour.

In the third class Hercules is similar to Webb's Wonderful, although that variety was entered and did not secure a place in the awards. Grand Admiral is a variety with red-tinted leaves, as is Winter Brown, which has a firm head somewhat bitter. Schofield's Hardy Winter is of medium size, has green leaves, and is a popular hardy variety. Reliance is a medium-sized plant with red-tinted leaves, and Early French Frame is a selection from Black-seeded Gotte, with yellowish-green foliage, small size, very compact, foliage somewhat blistered, head firm and of good quality.

All of these varieties of hardy winter lettuces to which awards have been given have, with the exception of Hercules, which is a "crisp" variety, leaves with a smooth surface with what is commonly referred to as a "buttery" texture. In the colder districts here especially, the varieties Brittany Winter White and White Madeira deserve a careful trial, while the variety All-the-year-round is worthy of more consideration under such conditions. Early French Frame is also outstanding in its class. There are a number of "strains" of these varieties in commerce, and it is important to take the greatest care to obtain the most suitable.

The cos lettuce, which derives its name from an island in the Greek Archipelago, originally known as Cos, is a very sweet, crisp, palatable salad plant, and, while not approved by the market, is well worth a place in the private garden. It was not conspicuous in the above-mentioned trials for winter cropping, neither is it so amenable to hot, dry situations as some cabbage varieties; but under good conditions the tall lettuces of this class produce a heavy crop that is usually of excellent quality. Paris White and Lobjoit's Green are popular varieties.

Other Vegetables.

In the colder localities early crops of globe beet, white turnips, short-horn carrots, parsnips, radishes, peas, onions, parsley, lettuce, cabbage, and cauliflower are still being sown. Elsewhere preparations are being made to plant main crops, to be closely followed by such half-hardy crops as French beans, marrows, corn, &c.

Crops sown during the month of September in most districts with a climate of average temperatures here are main crop potatoes, carrots, beet, spinach, and, where summer cabbage is difficult, silver beet; also Brussels sprouts, celery, and leeks for planting out main crops early in the New Year or thereabouts.

Potatoes on the market have much improved since greater interest has been taken in the quality of the "seed" sown. This has led to an increased interest in the cooking, and as a result the potato is again resuming an important place on the menu. There is no more important axiom in cropping than the statement one cannot reap better produce than they sow. Speaking generally, fresh certified seed should be sown each year in the warmer districts; elsewhere fresh stocks every two or three years may be satisfactory. For small areas where certified seed is not used table potatoes of good quality may be cut into pieces with one or two eyes each and planted without delay. The opportunity should be taken to examine the flesh of the tuber, and if any sign of disease or abnormal condition is present it should not be planted. If these precautions are observed and the principles of crop rotation are practised, there will usually be a creditable crop to harvest. On farms where this is a leading crop, the seed is sown with a mechanical planter or ploughed in: on smaller areas the ground

after harrowing down is scored with a marker to indicate the rows, and the seed is planted along the drills by means of a short-handled grubber. The use of a dibber is not generally recommended, as it is more difficult to control the depth of the planting. In the home garden planting is often done as the ground is being dug. Early crops are planted rather close, as they are usually dug before they ripen. For the main crop 15 in. to 18 in. between the sets and 28 in. between the rows is suitable for most varieties that are grown.

Good land newly broken in will produce a satisfactory crop without manures; but otherwise a dressing of fertilizers is necessary. In the absence of any well-established local practice a mixture composed of 3 parts superphosphate to one part sulphate of ammonia may be used at a rate of 4 cwt. or 5 cwt. to the acre; on heavy land this rate is sometimes doubled, in which case it will often be an advantage to replace a portion of the superphosphate with bonedust. On light soils the addition of 1 cwt. of sulphate of potash may be an advantage. Nitrogenous manures should be used with some caution, as a rank growth predisposes the crop to the attack of fungous blights. The fertilizer is drilled in before or at the time of planting: on small areas it may be used at a rate of 4 lb. to 100 plants, which is equal to 5 cwt. per acre. Specially important is it to harrow the ground two or three weeks after planting, before the plants are through the ground, to break up the surface crust and destroy seedling weeds. If this is repeated as necessary it will greatly reduce the labour of weeding and improve the tilth for moulding up.

In warm districts a full supply of carrots and beet can be obtained by sowing early-maturing varieties in spring and autumn. But in colder localities an autumn crop of that kind is not satisfactory, and winter supplies are best obtained by sowing main crops of these roots towards the end of the month of September. Types with fairly long roots of good quality are most profitable. If sown earlier the long season of growth is inclined to make them coarse.

The tomato and other half-hardy crops sown recently and placed in a hot-bed should be pricked off, so soon as the plants are large enough to handle, into other boxes, spacing them about 2 in. apart. The plants are handled by the leaves, as the slightest bruising of the stem at this tender stage of growth causes serious injury.

Where slugs or snails are troublesome it should be remembered that powdered bluestone or alum is a powerful destroyer of pests of this kind. Alum may be freely applied after sundown as a dry powder, or dissolved at a rate of ¼ lb. to ½ lb. to a gallon of water. When dealing with large areas it is sometimes an advantage to mix the powdered alum with twice its weight of lime-hydrate before broadcasting the mixture very lightly. Bluestone finely ground is often mixed with kainit at the rate of 1 part to 20 and broadcasted at a rate of 1 oz. to the square yard; it should not be allowed to lie on the foliage.

The Homestead Garden.

Odd corners may be brightened by the expenditure of very little labour by sowing now hardy annuals in fairly large areas of each kind. Well-grown sweet peas, nasturtiums, mignonette, &c., are of a quality equal to some of the best.

Foliage pot plants about the house which require repotting may be given that attention during the month of September. A fresh loam with sufficient humus to retain water and sharp sand to keep it friable will give the best results. Until the plants are thoroughly re-established after potting they should be watered sparingly.

The bright vigorous condition which is so admirable in plants is very desirable in the lawn, which perhaps is the chief feature in the formation of an adequate setting for the brighter flowering plants and trees. To assist in getting rid of weeds and mosses and strengthen the grass, applications of sulphate of ammonia and sulphate of iron at intervals

during the spring and early summer are not to be excelled. Mix well 3 parts sulphate of ammonia, 1 part of powdered sulphate of iron, and 20 parts screened sand, and broadcast it over the lawn at the rate of 4 oz. to the square yard—repeating the application at intervals of one month. Where the condition of the lawn is poor, a stronger mixture made by reducing the sand ingredient by one-half may be tried.

—*W. C. Hyde, Horticulturist, Wellington.*

WEATHER RECORDS: JULY, 1936.

Dominion Meteorological Office.

NOTES FOR JULY.

JULY preserved the character of the preceding portion of this year for a prevalence of fine and mild weather interspersed with phenomena of record-breaking intensity. Though temperatures were below normal and hard frosts were numerous, especially in the North Island, stock and vegetation do not appear to have suffered to any extent. Stock, indeed, are almost everywhere reported to be in good condition, and ample feed is available. Vegetation seems to be further advanced than usual, there being signs of growth, particularly in the leaf-buds of trees. Spring flowers, also, are commencing to bloom. In heavy soils the ground is waterlogged and cultivation at a standstill. The cold spell which was setting in at the end of the month may prove to be the cause of some damage.

Rainfall.—In the North Island, though the rainfall was in general above average, there were numerous exceptions. Thus, the Auckland Province, from Russell southward to Tauranga, received less than the normal amount. So also did parts of Taranaki and Hawke's Bay. In the South Island, Nelson and the West Coast had somewhat less than normal, but elsewhere the month was a very wet one. Numbers of places in Otago had double the average fall. Wet days were more numerous than usual, the only spell of settled weather occurring in the third week.

Temperatures.—Temperatures were everywhere below the normal for July. In western districts from Taranaki southwards the departures were generally only slight, but in most of the rest of the country they were somewhat over a degree. The South Island experienced frosts in approximately the average number and intensity. In the North Island, however, from one end to the other they were unusually numerous and sharp. At this time of year and in the fine and relatively windless weather in which they occurred, they were responsible for little damage. There is a considerable amount of snow on the mountains.

Sunshine.—In general, the amount of sunshine did not differ greatly from the average, and there was no marked general trend in the departures. Of two places rather near each other, one would have rather more and one rather less than normal. Tauranga had 177·4 hours, Nelson 163·0, and Napier 158·8 hours.

Pressure Systems.—The weather of the first week was very unsettled, with general rain on most days. Violent storms passed on the 3rd and on the morning of the 6th. On the 3rd there were westerly gales over the North Island and south-westerlies in the South. Snow fell to low levels on the ranges, and there were numerous hailstorms. Early on the morning of the 6th barometers at the Bluff and in the vicinity reached the record low level for New Zealand of 28·33 in. Though not so low elsewhere, the readings in many places transgressed all previous records. From the 5th to the 6th severe westerly gales were experienced in most parts of the country. The rain was heavy, and in a few places moderate flooding occurred. Numerous hail and sleet showers were again reported, with snow down to low levels on the hills.

After strong southerly winds on the 7th, which in places reached gale force, fine weather ruled in most places until the 16th.

Another rather severe storm approached from the Tasman Sea on the 16th, and by the 21st heavy rains had fallen everywhere. Northerly gales blew on the 18th and 19th about and north of Cook Strait. Otherwise, from the 19th till the end of the month, there was a strong prevalence of southerly winds.

On the 27th and following days heavy and general rains fell. On the 30th southerly gales set in and continued till the 1st August.

RAINFALLS FOR JULY, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
	North Island.					
	In.		In.	In.	In.	In.
Kaitaia	6·44	21	1·55	5·48	34·46	33·64
Russell	6·84	17	2·16	5·27	64·11	32·60
Whangarei	4·64	21	1·28	7·19	41·50	38·79
Auckland	5·23	24	1·67	5·58	30·60	29·86
Hamilton	5·70	20	1·57	5·10	33·19	29·00
Rotorua	5·95	12	2·08	5·00	42·39	31·85
Kawhia	8·48	13	1·94	6·01	34·98	31·55
New Plymouth ..	6·32	21	1·34	6·38	34·58	34·92
Riversdale, Inglewood ..	9·68	22	3·00	10·06	55·41	58·71
Whangamomona ..	8·26	12	2·14	7·27	43·00	42·97
Hawera	4·32	16	0·97	4·22	26·94	25·61
Tairua	4·62	16	1·31	6·31	35·47	39·87
Tauranga	4·76	16	1·39	4·94	38·04	31·82
Maraehako Station, Opotiki	5·78	14	1·12	4·45	39·17	32·24
Gisborne	3·84	17	0·85	5·05	32·31	29·96
Taupo	5·13	18	1·58	3·87	31·42	25·23
Napier	4·05	17	1·04	3·27	37·64	19·35
Hastings	2·49	14	0·64	3·66	32·67	20·29
Whakarara Station ..	4·74	14	0·71	..	40·42	..
Taihape	4·05	25	0·68	2·97	30·00	20·78
Masterton	5·12	19	1·21	4·18	33·14	22·95
Patea	5·60	20	1·17	4·23	30·23	25·63
Wanganui	4·55	14	1·15	3·34	26·83	21·04
Foxton	3·59	17	0·60	3·11	24·24	18·38
Wellington	8·42	21	1·82	4·85	35·83	25·74
	South Island.					
Westport	6·38	13	1·41	8·30	37·68	54·80
Greymouth	7·73	14	2·17	7·93	42·98	57·49
Hokitika	6·73	13	1·85	8·96	44·32	64·05
Ross	9·27	10	3·81	9·18	51·86	71·95
Arthurs Pass	11·37	7	4·93	9·93	60·32	85·87
Okuru, South Westland	8·64	7	2·75	10·52	72·31	82·56
Collingwood	9·13	14	1·75	9·40	48·90	54·96
Nelson	3·05	11	1·07	3·48	19·33	21·80
Spring Creek, Blenheim	3·82	14	1·40	3·42	21·32	17·89
Seddon	3·11	13	1·31	2·40	17·83	14·72
Hanmer Springs ..	7·92	20	1·49	4·29	37·26	26·06
Highfield, Waiau ..	3·69	18	0·80	3·34	26·98	20·08
Gore Bay	5·18	18	1·23	2·80	26·07	18·67
Christchurch	4·00	18	0·87	2·54	23·30	15·17
Timaru	3·03	11	0·76	1·84	21·10	12·98
Lambrook Station, Fairlie	2·63	13	0·61	2·62	18·01	14·60
Benmore Station, Clearburn	4·01	14	1·70	1·74	13·51	14·54
Oamaru	2·56	13	0·50	1·72	17·62	12·70
Queenstown	3·44	12	1·10	2·03	18·46	17·38
Clyde	1·37	11	0·31	0·90	8·04	8·66
Dunedin	6·74	18	1·15	2·98	27·93	21·06
Wendon	2·67	17	0·50	1·74	17·43	17·22
Balclutha	4·87	17	0·90	1·78	18·71	14·49
Invercargill	4·83	22	0·68	3·27	25·98	26·58
Puysegur Point ..	8·26	23	1·01	6·15	47·74	48·41